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See Page 41

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**GET RID OF
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DON'T RISK another day driving with winter oil! Hard winter wear dirties oil—and winter “choking” dilutes it!

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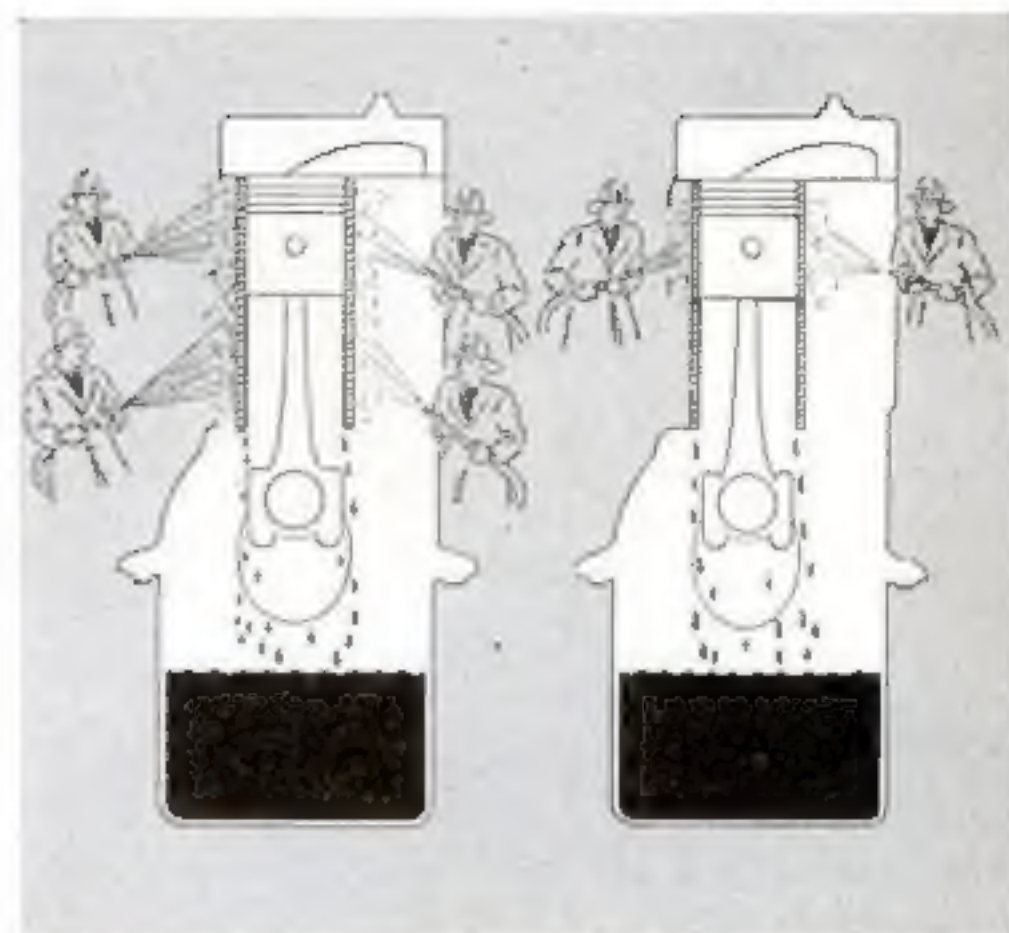
SOCONY-VACUUM OIL CO., INC.



**See the 1936 Mobiloil
chart for correct grade for your car**

Why Modern Cars "Live" so Long—

NEW DEVELOPMENTS OF RESEARCH
PROVIDE AMAZING DEPENDABILITY IN
CARS OF TODAY



FULL-LENGTH water jackets reduce temperatures.



FROM RADIATOR to tall-light the big, new 1936 Plymouth is engineered and built to stand up.

AMONG THE 1936 AUTOMOBILES, the new Plymouth is an impressive example of the advances engineers have made in automobile dependability and stamina in the past few years.

Floating Power engine mountings—exclusive to Plymouth among leading low-priced cars—and the heavy, balanced four-bearing crankshaft, eliminate the usual wear and tear of vibration.

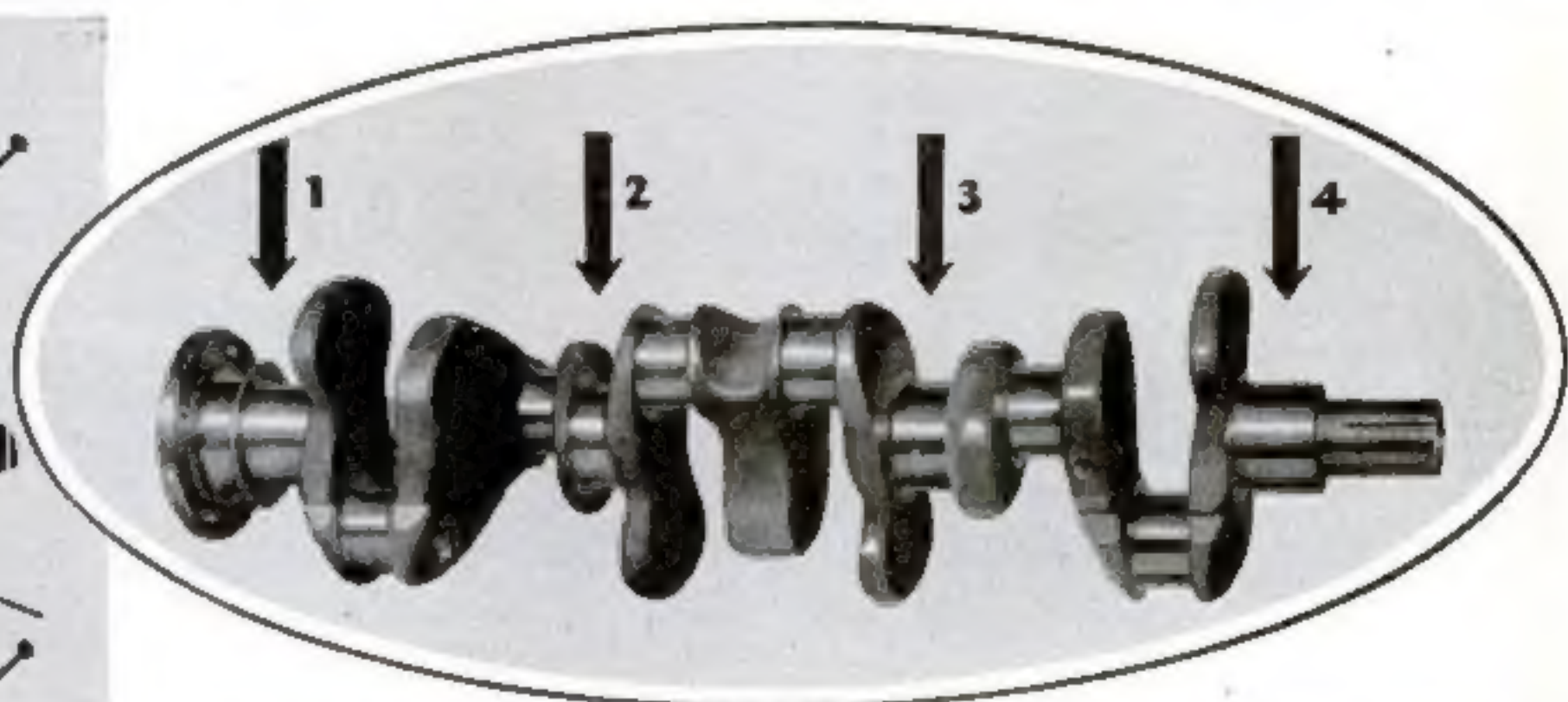
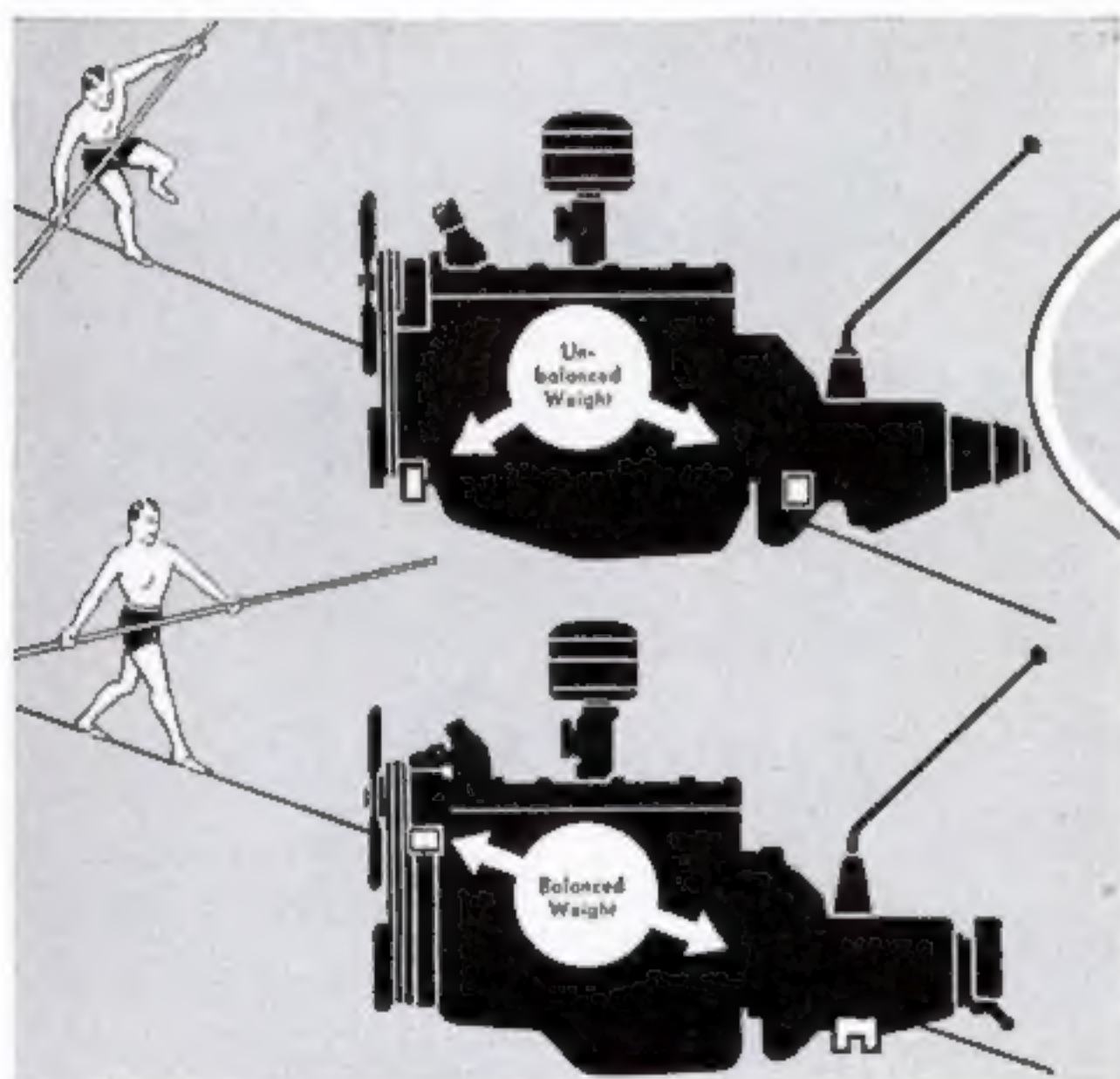
Calibrated ignition, which makes possible Plymouth's extremely high compression, save gasoline. Full-length water jackets plus full pressure lubrication, save oil. These two features further lengthen engine life. The clutch is air cooled, which not only prolongs the life of the mecha-

nism, but makes it 30% easier to operate.

Plymouth's All-Steel Body and extra rigid frame are put together as a unit... one reinforces the other... for greater safety and longer car-life. 100% Hydraulic Brakes are always equalized... saving adjustment and relining... and giving the safety modern traffic demands.

THERE ARE DOZENS of long-life features... exclusive with Plymouth. Drive the big 1936 Plymouth yourself... any Chrysler, Dodge or De Soto dealer will be glad to arrange it. Prices are only \$510 and up (list at factory, Detroit. Special equipment extra).

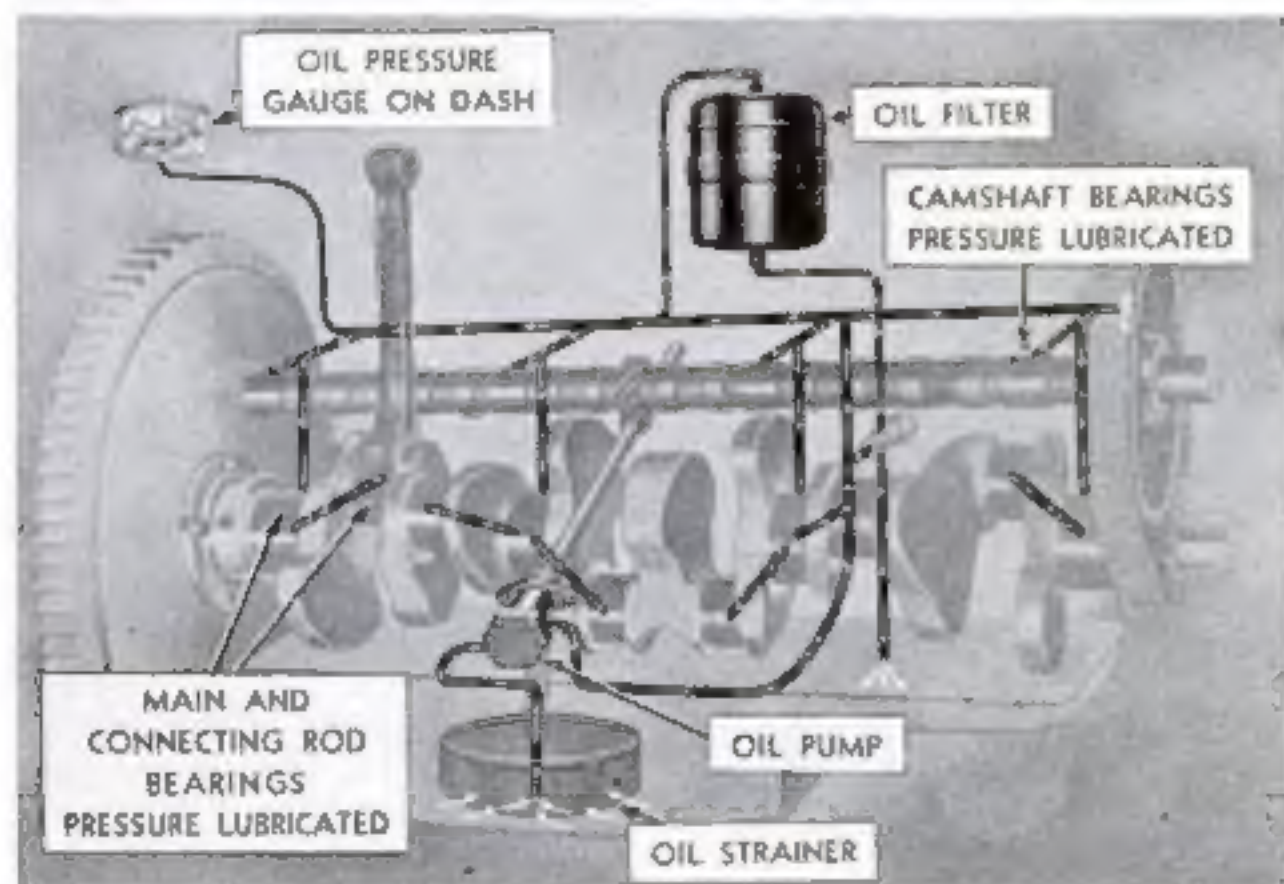
PLYMOUTH DIVISION OF CHRYSLER CORP.



PLYMOUTH HAS FOUR MAIN BEARINGS—not three as are found in many low-priced cars. These eliminate deflection and vibration and add to the life of the motor.

(Left) ORDINARY ENGINE mounting, off balance. Floating Power, perfect balance. Vibration is dissipated, for longer life.

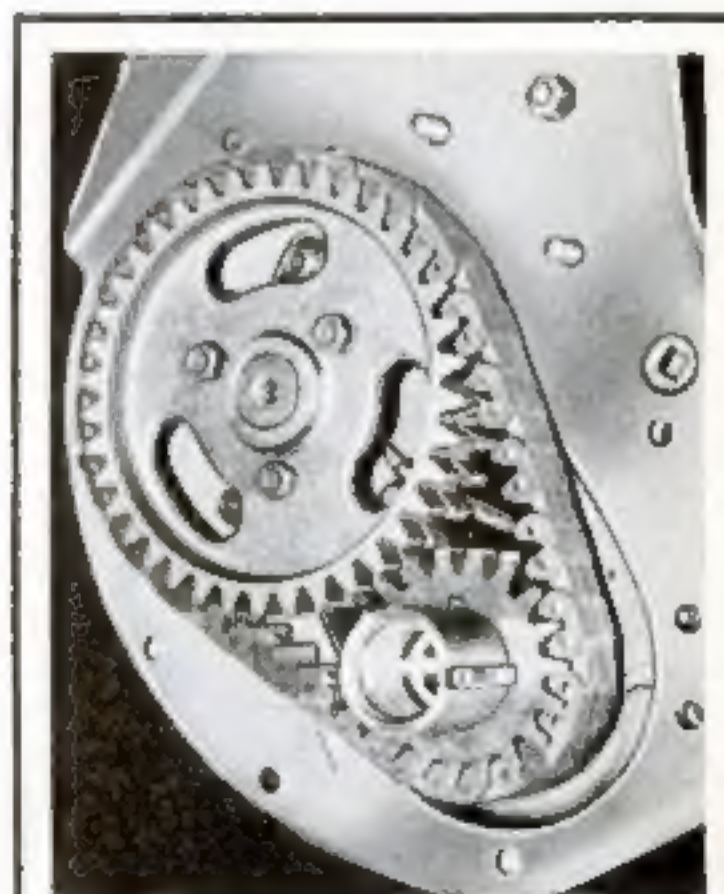
(Below, left) PLYMOUTH'S FULL PRESSURE lubrication leaves nothing to chance. Moving parts protected at all times.



Insist on the
Official Chrysler Motors
Commercial Credit Company
6% TIME PAYMENT PLAN

Available through all PLYMOUTH dealers
PAY \$25 A MONTH, INCLUDING EVERYTHING

You pay for credit accommodation only $\frac{1}{2}$ of 1% per month on your original unpaid balance. To arrive at your original unpaid balance: 1. Add cost of insurance to cost of car. *2. Deduct down payment—cash or trade-in. Result is *Original Unpaid Balance*. *(In some states a small legal documentary fee is required.)



SILENT CHAIN camshaft drive... is more expensive but more efficient! Another example of Plymouth policy: to give the best in lasting quality.

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POPULAR SCIENCE

FOUNDED MONTHLY 1872

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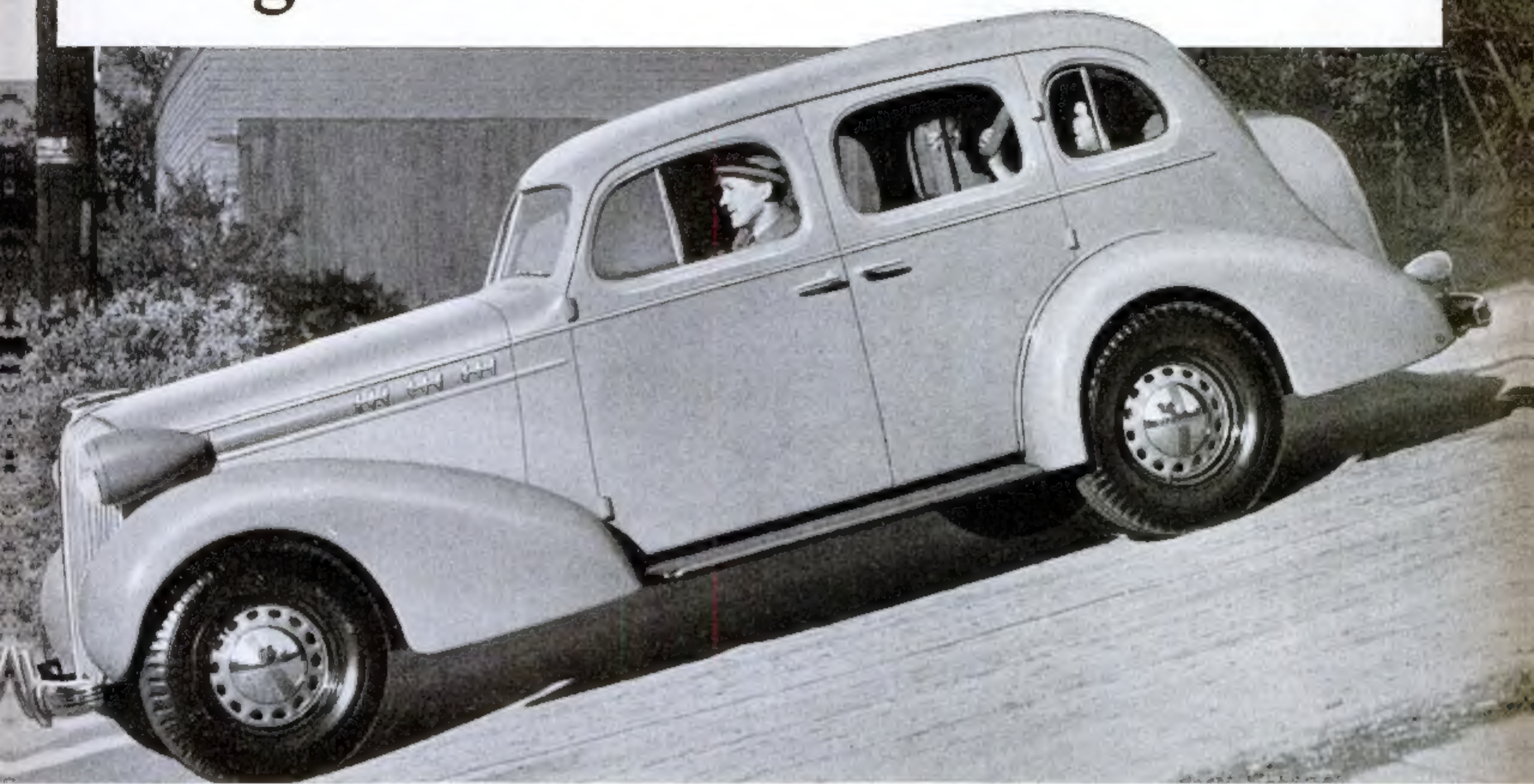
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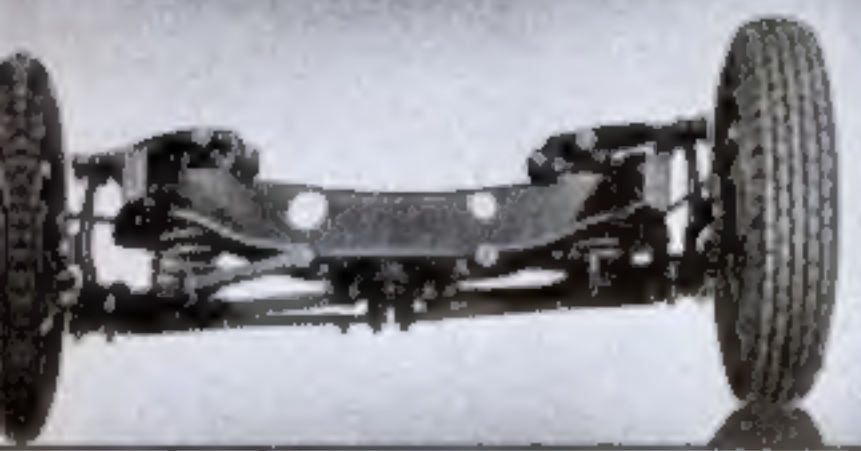
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How EXTRA SAFETY is engineered into Oldsmobile



KNEE-ACTION WHEELS



SUPER-HYDRAULIC BRAKES

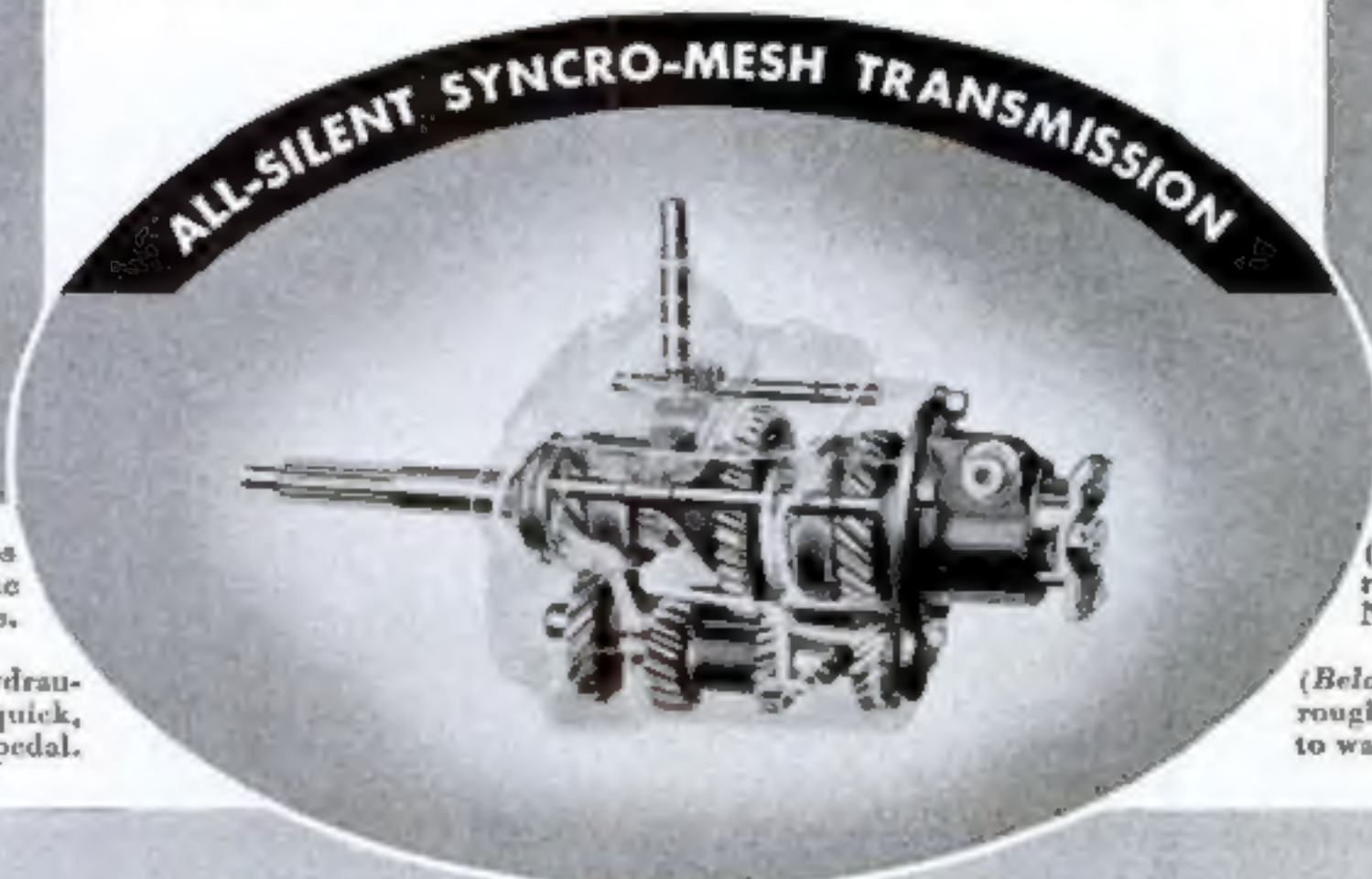


(Above) Big, rugged Knee-Action Wheels "step over" bumps and holes . . . provide greater stability on rough roads. The Stabilizer prevents body roll and sidesway on curves.

(Below) Powerful, self-energizing, self-equalizing Super-Hydraulic brakes with extra large braking area, bring your car to a quick, smooth, straight-line stop at the lightest pressure on the pedal.

OLDSMOBILE gives you Safety Glass all around at no added cost. Oldsmobile gives you big, low-pressure tires for extra traction in stopping. Oldsmobile gives you Multi-Beam headlights for safer night vision. But what is more important still, Oldsmobile gives you a car into which safety is basically engineered. Some of Oldsmobile's advanced safety features are illustrated on this page. For full appreciation of Oldsmobile's many factors of security, write for Catalog and Complete Engineering Information. If you are interested in checking other cars against Oldsmobile, ask for the Oldsmobile Compar-o-graph. Address Olds Motor Works, Lansing, Michigan.

(Below) With All-Silent Syncro-Mesh Transmission, shifting is quiet, positive and effortless. Changing gears in emergencies, even from high back to second, is a simple and sure operation . . . a contribution to driving safety.



SOLID-STEEL "TURRET-TOP" BODY BY FISHER



CENTER-CONTROL STEERING



(Above) In Oldsmobile's Solid-Steel "Turret-Top" Body, you ride protected by steel over head, under foot and all around. No Draft Ventilation guards against fogging of windshield.

(Below) With Center-Control Steering, you hold a true course on rough roads or smooth, easily and surely. There is no "tendency to wander" and road shocks are never transmitted to the wheels.

OLDSMOBILE \$665

"The Car that has Everything"

Sixes \$665 and up . . . Eights \$870 and up. Net prices at Lansing, subject to change without notice. Safety Glass standard equipment all around. Special accessories groups extra. The car illustrated is the Six-Cylinder 4-Door Touring Sedan, \$820 list. New G. B. M. A. C. Time Payment Plan. • A General Motors Value.

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In This Issue—Hundreds of Fascinating Articles Tell the Latest News of Laboratory Discoveries, Scientific Triumphs, and Amazing New Inventions

THE NATION'S *Calling* LIST



THE telephone directory is the nation's calling list. Millions of people refer to it daily—in homes and offices and in public pay stations. It is the busiest book—it plays a part in countless activities.

For the names in the telephone book are more than names. They are friendships and homes and families. They are bridge parties and golf games—business successes—buyers and sellers of wheat or pins or skyscrapers.

More than 12,000,000 names are listed in the directories of the operating companies of the Bell System. You can go straight to any one of these millions of people—easily, quickly and economically—by telephone.

The classified directory is an important feature of your telephone book. It is a handy, reliable buying guide—a quick, easy way to find "Where To Buy It."

BELL TELEPHONE SYSTEM



all NEW CARS NEED SIMONIZ



Whatever make of car you have, be sure to Simoniz the finish. It keeps new cars looking new for life. Makes old cars look like new again. And no type of finish can be expected to last long and stay beautiful without the all-weather protection of Simoniz. So Simoniz your car—the sooner, the better. Get world-famous Simoniz and Simoniz Kleener today. Insist on them for your car! They're faster, safer, easier to use. Inexpensive! Dependable!



Motorists Wise
SIMONIZ

Home-Repair Ideas

FOR THE HANDY MAN



Two-section screen installed from inside the house. The catch holds lower section in place

WINDOW SCREENS GO ON FROM THE INSIDE

FULL-LENGTH screens can be put on windows from the inside, under a new arrangement worked out by a manufacturer of sash and doors. The plan requires the addition of three pieces of special molding to the outside casing; screens are made in half sections which can be handled easily by the housewife. The upper section is first inserted in the grooved molding and pushed up to the top of the window, where it is held by a catch; the lower section is then inserted. To permit the cleaning of the sill from the inside, the bottom molding strip is removable. The same installation takes care of similarly built storm windows. The lower half of the sash can be swung inward for ventilation.

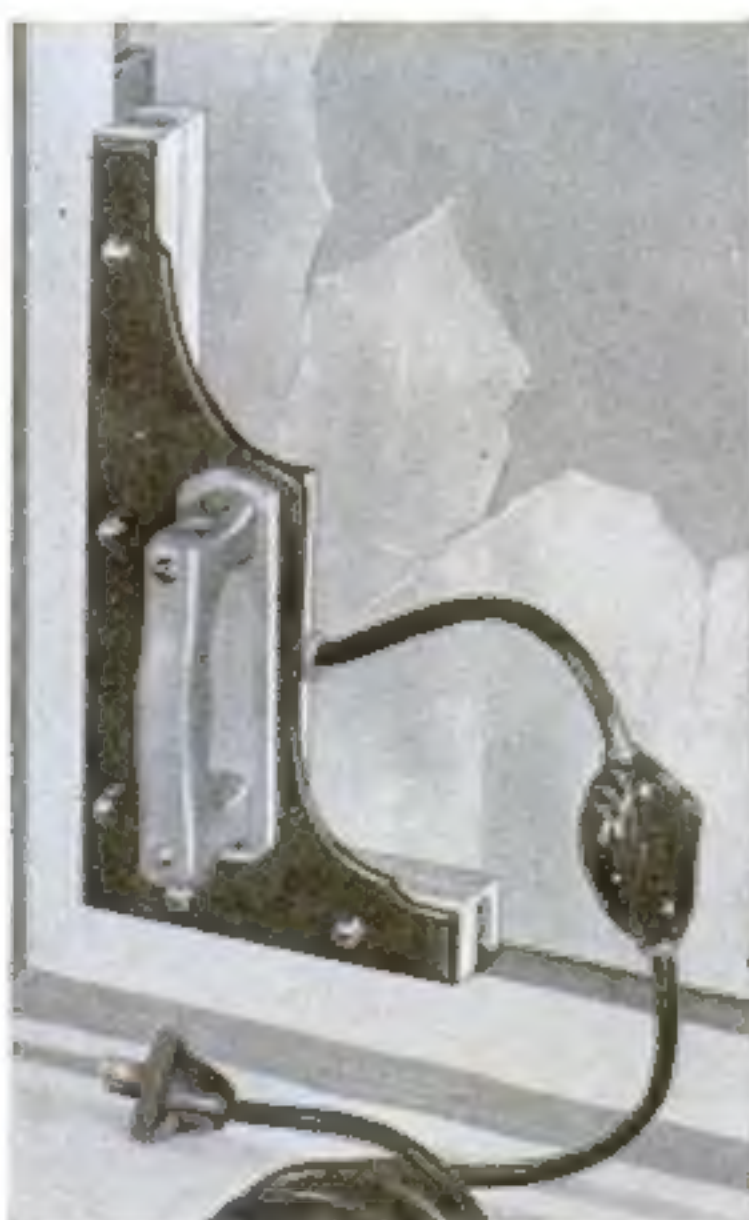
CARTRIDGE CALKING GUN

Using one-quart cartridges sealed at the factory, a new calking gun does away with the usual mess of loading a gun with calking compound. High pressure is developed by a system which dispenses with pawls and ratchets; a plunger rod, moved by the squeeze trigger, forces the material out through a fine nozzle. A special advantage claimed for the gun is that the user can carry extra cartridges while working on a ladder or swing.



ELECTRIC PUTTY SOFTENER

By the use of the handy appliance illustrated at the left, large pieces of glass can be removed from window frames and other places with ease and safety. A heating element built into the right-angle frame is operated through a plug-in cord from any convenient outlet, warming the putty until it is sufficiently soft. No damage is done to the sash by the operation.



An electric heating element in the right-angle frame of this novel appliance warms putty to soften it so that large pieces of glass can be removed safely from sash. Its use does not mar wood

LUMINOUS WALL-SWITCH PLATE



ONE two-thousandth of a watt of current is all that is required to operate a new, permanently luminous wall-switch plate. Anyone can install it on an ordinary wall switch. Shining only when the switch is off, it produces a cold light so that it will not burn out.

Questions

FROM HOME OWNERS

Q.—How can I make paint stick to outside wood trim originally finished with creosote shingle stain? Also, what should I use to patch cracks in dash-finished stucco?—H. O. C., St. Joseph, Mo.

A.—CREOSOTE stain is difficult to cover with paint and has a tendency to "bleed" through and discolor the finish. First remove the present coat of paint from the trim by scraping and sandpapering. Then apply a priming coat of aluminum powder mixed with outside spar varnish and finally a high-grade house paint. Stucco can be patched with a mixture of one part cement and two parts fine-screened sand.

SELECTING WIRE SCREENING

P. G., PHILADELPHIA, PA. Insect screening is commonly sold in grades varying from No. 12 to No. 14, the figures designating the number of wires for each lineal inch. Screening of No. 14 mesh is considered as generally satisfactory.

INSTALLING WINDOW SHADES

S. W. C., MILWAUKEE, WIS. When hanging roller shades, the general practice is to locate the bracket having the pivot hole on the right side and the slotted bracket at the left. When ordering inside shades, measure the distance between stops at the top of the window, making the measurement accurate to within 1/16 inch.

PAINTING CRUMBLY PLASTER

Q.—IS IT possible to make a coat of paint stick to a plaster wall whose surface is crumbly? It seems to be covered with a soft chalklike dust.—F. T., Chicago, Ill.

A.—ALL SURFACE POWDER should first be removed with a painter's duster or a large bristle brush, taking care not to mar the surface and patching all large defects. Then apply a coat of varnish size, followed by a priming coat of flat wall paint or a mixture of half flat wall paint and half size. Finish with two or three coats of paint. Do not apply the paint too heavily.

DEFLECTOR FOR EAVES TROUGHS

Q.—THE BOX-TYPE eaves troughs on my house were not installed properly. Rain works its way back under the roof shingles instead of dripping into the gutters. Can you suggest a remedy?—W. M., Forest Hills, N. Y.

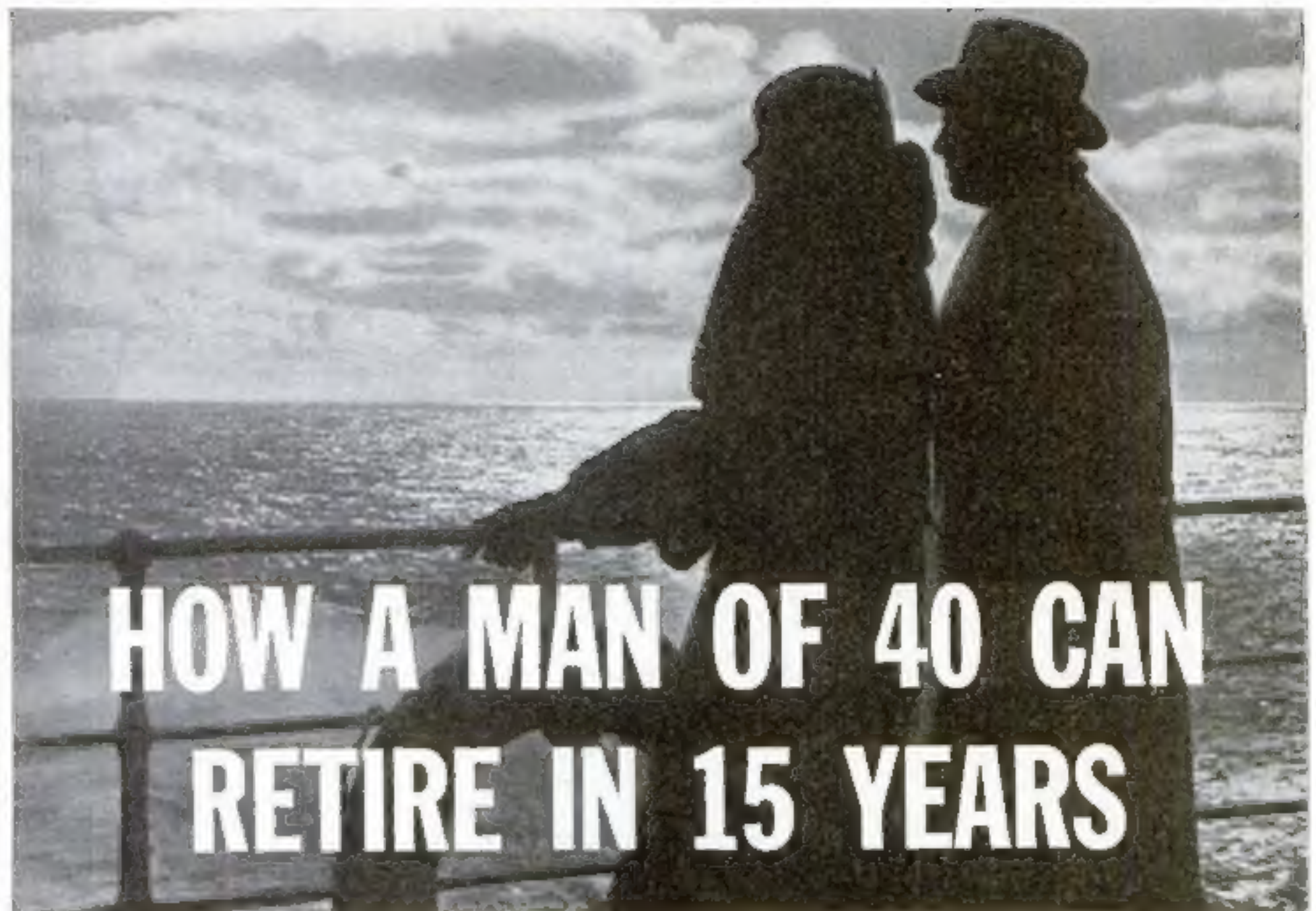
A.—THIN SHEET COPPER forced up under the ends of the last row of shingles and bent down inside the trough should solve the problem. Rain from the edge of the roof then will be forced to follow the copper into the trough.

INSIDE AND OUTSIDE VARNISH

D. S., SPOKANE, WASH. Varnishes sold for interior work never should be used out of doors. Interior varnishes contain less oil than exterior varnishes and will not stand up under severe weather.

REPLACING SLATE SHINGLES

J. W. W., FLINT, MICH. A cracked slate shingle can be removed by inserting a nail-cutting saw up under the shingle and using it to saw through the two nails that hold the shingle in place. Two brass clips fastened to the upper end of the under shingle will hold the new shingle in place.



IT makes no difference if your carefully laid plans for saving have been upset during the past few years. It makes no difference if you are worth half as much today as you were then. Now, by following a simple, definite Retirement Income

Plan, you can arrange to quit work forever fifteen years from today with a monthly income guaranteed you for life. Not only that, but if you should die before that time, we would pay your wife a monthly income as long as she lives.

\$200 a Month beginning at age 55

Suppose you decide that you want to be able to retire on \$200 a month beginning at age 55. Here is what you can get:

1 A check for \$200 when you reach 55 and a check for \$200 every month thereafter as long as you live.

This important benefit is available alone; but if you are insurable, your Plan can also include:

2 A life income for your wife if you die before retirement age.

3 A monthly disability income for yourself if, before age 55, total disability stops your earning power for 6 months or more.

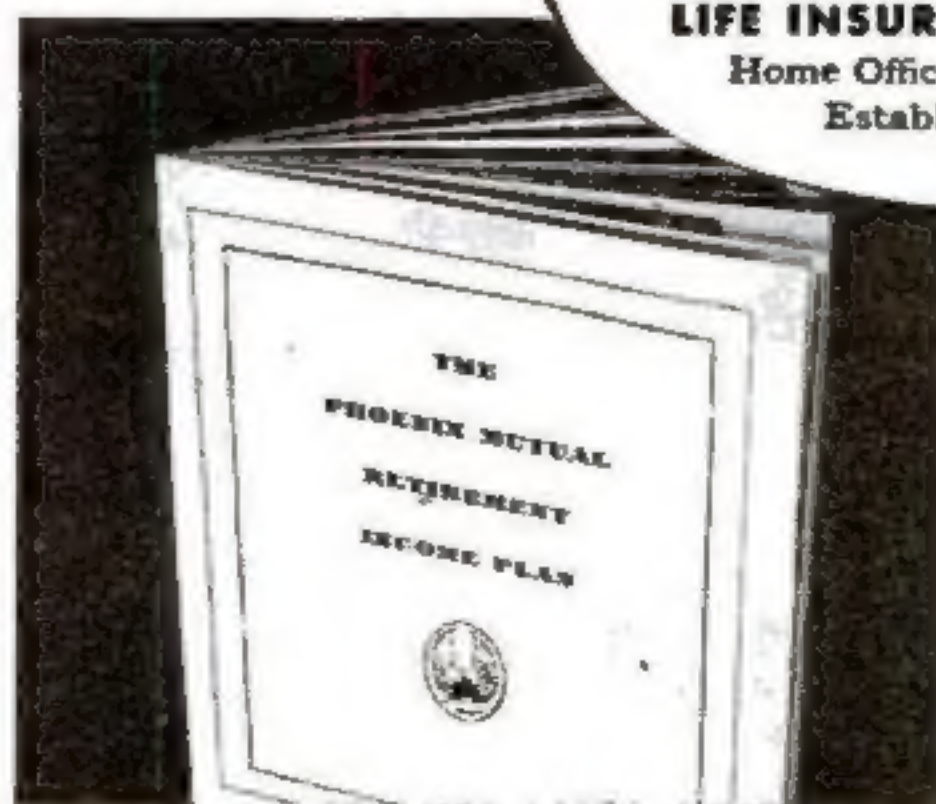
This Retirement Income Plan is guaranteed by the Phoenix Mutual, a company with over half a billion dollars of insurance in force and a record of more than 75 years of public service. If you want to retire some day, and are willing to lay aside a portion of your income every month, you can have free-

dom from money worries. You can have all joys of recreation or travel when the time comes at which every man wants them most.

The Plan is not limited to men. Similar plans are available to women. It is not limited to persons of 40. You may be older or younger. The income is not limited to \$200 a month. It can be more or less. And you can retire at any of the following ages that you wish: 55, 60, 65, or 70.

What does it cost? When we know your exact age, we shall be glad to tell you. In the long run, the Plan will probably cost nothing, because, in most cases, every cent and more comes back to you at retirement age.

Write your date of birth in the coupon below and mail it today. You will receive, without cost or obligation, a copy of the interesting illustrated booklet shown at the left. It tells all about the Plan. Send for your copy now. The coupon is for your convenience.



Send me by mail, without obligation, your new book describing THE PHOENIX MUTUAL RETIREMENT INCOME PLAN.

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PHOENIX MUTUAL
LIFE INSURANCE CO.
981 Elm St., Hartford, Conn.

Our Readers Say



One Woman's Solution Of Kettle-Shining Chore

BEING a new subscriber, I wish to congratulate you for the Our Reader Say pages. In fact, if the writers of these letters could write all your pages, the arrangement might have some merit because every would-be experimenter could then try out ideas that came from all parts of the country and from abroad. Now I'd like to give R.T., of Mobile, Ala., a way to get around the difficulty of keeping the family copper kettle shined. I had one that would not keep a bright and cheerful face so I bunged a hole in it and got an aluminum one. R. T. might try this provided his wife is not in on the plot. Rather heartily I join with P. R. F., Springfield, Ill., in his appeal for a running-board refrigerator for the car. This could be as useful as the automobile radio and not so loud. Neither would the family be so loud in their calls for food every time an attractive food emporium was passed. As a housekeeper, I suggest plans for a gadget that will, when properly installed, ring when the beans boil dry.—(Mrs.) L.C.D., Hamlin, Tex.



He May Be a Tyro Chemist But He's an Advanced Diplomat

AMONG the letters on the Our Readers Say pages of a recent issue, I noticed a letter from F.E.C., of Newport, Vt. His suggestion to advance the chemistry articles into the organic field is all right with me provided the magazine continues to run what F.E.C. calls the vinegar-and-baking-soda-type of chemistry. In other words, keep on publishing the simpler articles and experiments for those of us who aren't ready for more advanced chemistry.—P.C., Jr., Central Mercedita, Cuba.

Asks Way Out To a Better Landscape

As a sequel to your article in the April issue telling how to beautify a lawn, I suggest an informative article telling how a home owner of modest means can best "landscape" his grounds. This is a real problem both from the standpoint of securing an attractive layout and of planting shrubs and flowers which will thrive without the care of an expert gardener. I know that I, and several of my neighbors, have paid dearly for the lack of such advice. Most of the books available on this subject present ground-layout plans which entail too great a cost (in money and time) for the small home owner. If you can give a treatise, popular in scope, on this subject, I am certain it will benefit many of your readers.—S.P., Cleveland, Ohio.



Not Recommended If You're Going To Catch a Train

REPLYING to R.H.L., Denver, Colo., he can set his watch with the aid of the sun, provided he knows the compass directions, by the following method: Place the watch with its numeral 12 pointing directly south. On the edge of the time dial, find the point at which a match or similar object held upright will throw its shadow across the point at which the watch hands are affixed. When this position has been found, then twice the distance between the numeral 12 and the point at which the match stands will be approximately the correct time. For example if the match is at 11, the time is 10:00 A.M.; if at 1, it is 2:00 P.M. When the match stands at a minute subdivision, calculate twelve minutes for each of the minute marks beyond the last preceding hour mark.—H.E.H., Lewiston, Pa.

Too Much Civilization For Civil Engineer

As AN old-time civil engineer, I was deeply interested in the article you published some time ago, describing the proposed tide-power project at Passamaquoddy. It sounds like a real piece of work. However, my enthusiasm has been cooled a little by further details I have gleaned from the newspapers. It seems that the boon-doggers are now designing quaint little Colonial cottages for the engineers who will work on the project, furnished with Early American love seats and other tea-shoppe trimmings. Shades of Bowditch! In my day, any engineer worth his salt felt most at home in a pine-board shack littered with blueprints, and with a transit leaning up in a corner. As for a love seat, he wouldn't know what to do with one. If engineers are going to wear smocks and berets, I don't want to live down the valley below any dams they build.—J.B., Birmingham, Ala.



A Fencer Sends a Letter As His Second

THIS letter comes to second the motion of D.H.S., of Philadelphia, Pa., that your excellent magazine publish a few articles on the art of fencing. In so doing you might include instructions for making much of the needed equipment at home.—H.B., Minneapolis, Minn.

Eager To Know More About Medicine and Mind

I WISH to register my agreement with J.E.B., Quebec City, Canada, that your magazine should publish some articles on the mental sciences. I also believe, as M.R.S., of Winnipeg, Canada, does, that there should be a continuation of the stories by Dr. Frederic Damrau which tell of interesting happenings

in the medical field. Lastly, I should particularly like to see some articles on qualitative and quantitative chemical analysis. I enjoy P.S.M. as it is but with these additions, it will be really perfect.—H.H.H., Brooklyn, N. Y.

There's a Catch, He Finds, In Beating the Alarm Clock

REPLYING to A.K., of Schenectady, N. Y., about his ability to wake up before his alarm clock rings, you may tell him he need not look to the psychology sharks for the answer. He can get the answer from any observant person who happened to be awake before the time at which his alarm was set to ring and heard the mechanical click that precedes the ringing of the alarm. Before this happened to me, I used to think that I was clever at getting up at any specified time. Since then I have noted that an audible click, sometimes accompanied by a single tap on the bell, precedes the ringing of the alarm by about thirty seconds. I always read the Our Readers Say pages very thoroughly and get a great kick out of them—the cartoons especially.—H.G.M., Nashua, N. H.



Wonders Why Air-Cooled Motors Have Been Slighted

WHY is it that air-cooled motors have not been generally adopted by manufacturers of automobiles? This is a question that has puzzled me for some time. The air-cooled cars that were made seemed to function as well as the water-cooled. Air-cooled motors operate satisfactorily on airplanes. Maybe some better informed reader knows the answer, if there is one.—H.E.H., Baltimore, Md.

Visions a Radio Set In Every Watch Pocket

RADIO inventors, I believe, should expend a greater effort to develop a pocket-size receiving and sending set—something about the size of a large watch and which would be no more cumbersome to carry. The construction of such a set would probably be based on some new principle. It would necessarily be one which would eliminate the use of relatively large batteries. This is a field of research that has been barely scratched. A radio of this type would have a universal use and think of its value to police, rescue parties, posses, miners, hunters, and explorers! It would open up a whole new field of communication. I do not think it is any dream

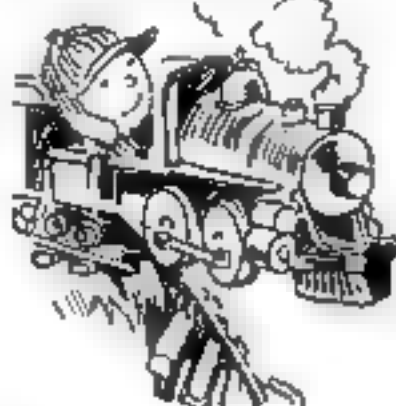


to predict that before many years such sets will be available and that they will be as indispensable to the average person as a watch is today.—H.L.W., Highland Park, Mich.

There's a Train of Thought In This Problem

As I enjoy Our Readers Say very much, I wish to offer a problem which I believe will interest many of the readers. Here it is: A brakeman, a fireman, and an engineer are employed on a train. Their names, not in respective order, are Robinson, Smith, and Jones. On the train are three passengers with the same names, hereinafter referred to as Mr. in order to distinguish them from the three trainmen. Consider now these facts: (1) Mr. Robinson lives in Detroit, (2) the brakeman lives exactly halfway between Detroit and Chicago, (3) Mr. Jones earns exactly \$2,000 a year, (4) Smith beat the fireman at billiards, (5) the brakeman's nearest neighbor, who is one of the passengers, earns exactly three times as much money per year as the brakeman, (6) the other passenger lives in Chicago and has the same name as the brakeman. What is the engineer's name? There is no trick to the solution of the problem.—W.D., Kansas City, Mo.

NOW WHAT WOULD THAT NAME BE?



Deep, Desert Well, He Says, Makes Day Stargazing Possible

A FEW issues back, on the Here's the Answer page, I noted a reply to a question which indicated that stars could not be observed in the daytime from the bottom of a deep well. At Randsburg, Calif., which is on the Mohave Desert, there is a deep shaft of an abandoned mine. The mine is no longer worked because of water at the lower levels—about 300 feet down—but the water has been used as a supply for a near-by mill. Looking up this shaft from about the 100-foot level, the sky appears the same as it does on a clear night. The stars shine brightly and you may know that the sky over the Mohave Desert is pretty well peppered with stars on a summer's night. When I first went to this property, the men thought it strange that I did not believe that such a sight could be seen but I descended the shaft and was soon convinced.—H.M. Van D., Lynn, Mass.

Gives His Satire a Ride On Exercising Machine

THE April issue of your magazine informed us about a machine which does your exercising for you. You sit on the contraption, push a button, and go for an artificial ride on a bicycle, horse, or in a rowboat. It is dubious, to me at least, if this invention spells progress. But it must be admitted that it is in keeping with a certain trend of our civilization. If you have enough money, you can hire some one to think for you, others to do all tasks requiring the expenditure of physical energy, and still others to entertain you. Up to the present writing, however, no mechanisms or processes have been introduced which will do your breathing for you or digest your food. How about it, inventors, do we get these needed aids to mankind? If so, the user need only raise his eyebrows to set his "activity" for another trying and strenuous day in motion.—T.L.C., Pittsburgh, Pa.

NO PROXY NEEDED TO LIFT YOUR FAVORITE BRAND!



Making an Area Broadcast Its Size

THE necessity of improvising a temporary aerial for my radio caused me to make what I think is an unusual observation. From it, I drew a conclusion which may or may not be correct. I'll leave that to the readers. I noted that the greater the surface area of the aerial, the greater was the volume of the speaker, and that the ratio of the area of one aerial to that of another was apparently in direct proportion to the speaker volume produced by each aerial. Is it possible then to measure areas by sound? Can a unit-area antenna yielding a unit-volume intensity of sound, preferably the steady hum of a key transmitter, be used for finding areas of metallic objects when the latter are used as antennas? Further, it is my belief that high-frequency currents travel well on poor conductors, such as non-metallic solids. If this is so, then by simply reading a sound meter which had a properly calibrated area scale for registering the results, the area of an object could be ascertained. Incidentally, would it be necessary to use a unit-area antenna of the same substance as the solid to be measured and would a differently calibrated area scale be needed to give the proper reading with varying materials yielding the same sound intensities?—M.G., Brooklyn, N. Y.

Thinks Autos Should Carry Telltale Speed Recorder

THERE is widespread interest at the present time in the movement to reduce accidents on our highways. Many means have been proposed and in some cases adopted to accomplish this result. Included among the former has been the suggestion to install governors on all cars to limit the speed of the engines. This, I think, would be of only limited value. Traffic and road conditions should be the guide to the use of speed and, at times, a quick response to the accelerator and fast movement of the car may be necessary to avert an accident. I believe a most effective step to increase the safety factor in motoring would be the compulsory equipping of all private cars, trucks, and busses with a time-speed recording device which would provide a continuous record of the speeds at which the automobile had been traveling. Periodic inspection of its working condition would be required. The fact that drivers would be aware that an indisputable check-up could be made of the car's speed would do more, I think, to curb recklessness than any mechanical control.—S.S.I., Savannah, Ga.



Change-Making Slot Machine Nominated as Bus Driver's Aid

AN ITEM which recently appeared in a local newspaper depicted the trials and tribulations of the operator of the one-man bus which is steadily pushing the old-fashioned trolley car off city streets. The driver's main duty is to steer, shift gears, and navigate his bulky bus through congested streets with as much speed and dispatch as is consistent with safety. But he also must open and close doors, collect fares, answer the questions of scores of Aunt Marthas, and, to top it all, he has to change the coins and bills of the passengers. It seems to me that the benighted driver could be relieved of this last duty if some reader of your magazine would take the time to invent an automatic change making machine. The device should accommodate dimes, quarters, and half dollars and eject in return the correct amount and proper kind of change. This would not take care of bills but it would remedy the situation to a con-

siderable extent. How about a solution to this annoyance?—M.W.E., New York City.

Stopping a Runaway Motored Model Boat

THE article, "Midget Motored Models," that appeared in your magazine a few months ago has indicated to me the need for an automatic device which would stop a model boat that is under way should the guide cord break or otherwise become loose. One suggestion I have to offer is that a spring catch, possibly based on the mouse-trap principle, might hold the tripper bar in operating position until there was a decided slackening of the tension of the control cord, which could be either accidental or intentional. This slackening would release the spring which would throw the tripper bar to the "Stop" position. An alternative suggestion is to have a drag or sea anchor attached which is held out of the water as long as there is tension on the control cord. Absence of the tension would permit the drag to fall and also throw the tripper to "Stop," either by direct action or through a mechanism as previously outlined. The ingenuity of the model-boat enthusiast could perfect or vary either of these suggestions.—H.S.R., New Rochelle, N. Y.



Wants Movie Films for Recordless Phonograph

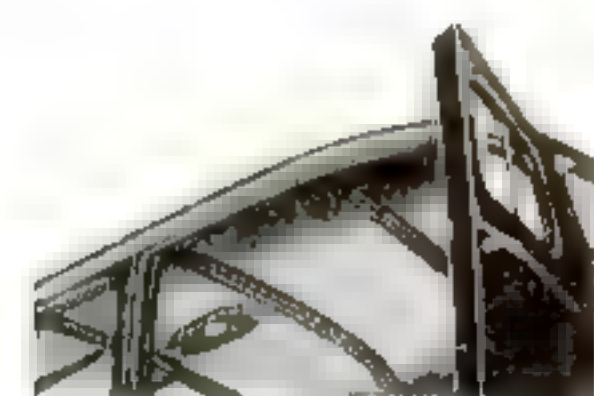
CONSIDERING the present-day phonograph, I cannot understand why it has not been displaced by a machine in keeping with modern developments long ago. Take the matter of records alone—they are fragile and always in danger of being broken so that they have to be handled like a crate of eggs when being moved about. It seems reasonable to me that the phonograph should have developed along the lines of a motion-picture sound projector so that today we would be using film, carrying the sound track, instead of outmoded records. I suggest that one of your radio wizards figure out something of this sort that can be built at a moderate cost and which operates through a standard radio set or amplifier. Plans for both recording and playing set-ups would be desirable.—J.C.F., LaCrosse, Wisc.

Oval Sprocket, Reader Recalls, Had Its Tryout Many Years Ago

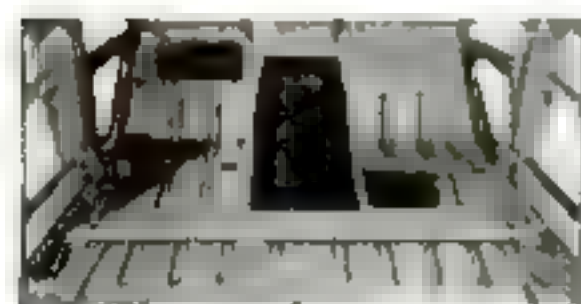
THE short article in a recent issue of the magazine telling of the use of an oval sprocket on a bicycle interested me very much. As a matter of fact, the idea of such a sprocket is not entirely new. No one, however, who is less than fifty years old would recall its use. This type of sprocket received attention when John S. Johnson, a prominent amateur bicycle racer of bygone days, made a mile, as I recollect, in 1:57 on a wheel fitted with one of these sprockets. The date I think was either 1891 or 1892. The following year a prominent bicycle manufacturer furnished this type of sprocket as optional equipment on his wheels. Quite a controversy raged in the papers of that period relative to the merits and demerits of such a sprocket. After about a year, the sprocket passed from the picture and in two or three years, it was forgotten by that generation of bicyclists.—H.H.B., Red Bank, N. J.



Of all low-priced cars
only Chevrolet puts the
**FORTRESS-LIKE SAFETY OF A
SOLID STEEL TURRET TOP**
over your head



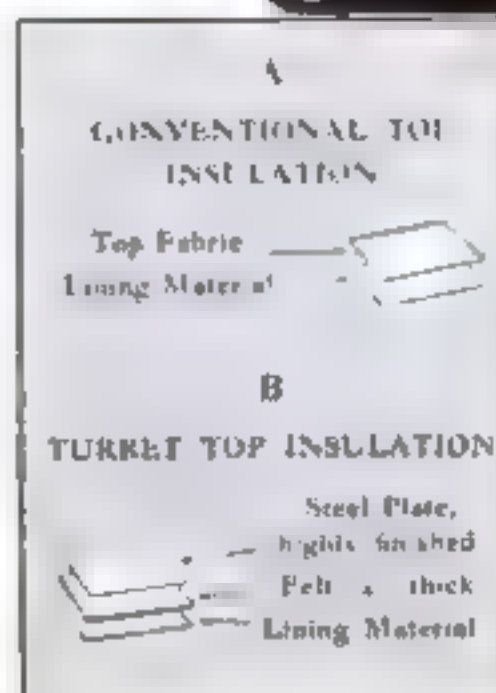
Chevrolet's Solid Steel one-piece Turret Top is reinforced by sturdy bows of heavy gauge steel. Similar reinforcing members are used at other points throughout the body.



Even the floor is formed from one piece of solid steel. You are protected overhead, on all sides and underfoot in the new Chevrolet.



Chevrolet has gone to extraordinary lengths to build *safety* into every part and feature of Chevrolet for 1936. The top of this car, for example, is the world-famous Turret Top—a solid sheet of seamless steel—a fortress of protection over your head. The cowl, the rear panel, the two side panels and the floor also are steel, heavily reinforced to give maximum strength and rigidity. This Turret Top construction—like New Perfected Hydraulic Brakes, Knee-Action*, Shockproof Steering* and many other important features—is exclusive to Chevrolet in its price range. It typifies Chevrolet's policy of giving that extra motoring safety which you naturally expect to find in *the only complete low-priced car*.
CHEVROLET MOTOR CO., DETROIT, MICHIGAN



Cooler in summer, too! A series of temperature readings taken under the tropical sun of Key West proved that Chevrolet's Solid Steel Turret Top gives much better protection against heat than ordinary fabric tops. Kaye Don, British sportsman, and Bill Cummings, national racing champion, assisted the A.A.A. observers who supervised the tests.

TEMPERATURE TEST

Take a piece of top fabric about six inches square, place it on a piece of headlining material the same size, put them out in the sun on a hot day—with an ordinary thermometer under them. Do the same with a six-inch piece of highly finished steel and a piece of headlining material. Then read the thermometers, and you'll vote—*Turret Top!*

Only Chevrolet brings you these five other famous features so important to complete motoring satisfaction

NEW PERFECTED HYDRAULIC BRAKES . . . IMPROVED GLIDING KNEE-ACTION RIDE* . . . GENUINE FISHER NO DRAFT VENTILATION . . . HIGH-COMPRESSION VALVE-IN-HEAD ENGINE . . . SHOCKPROOF STEERING*

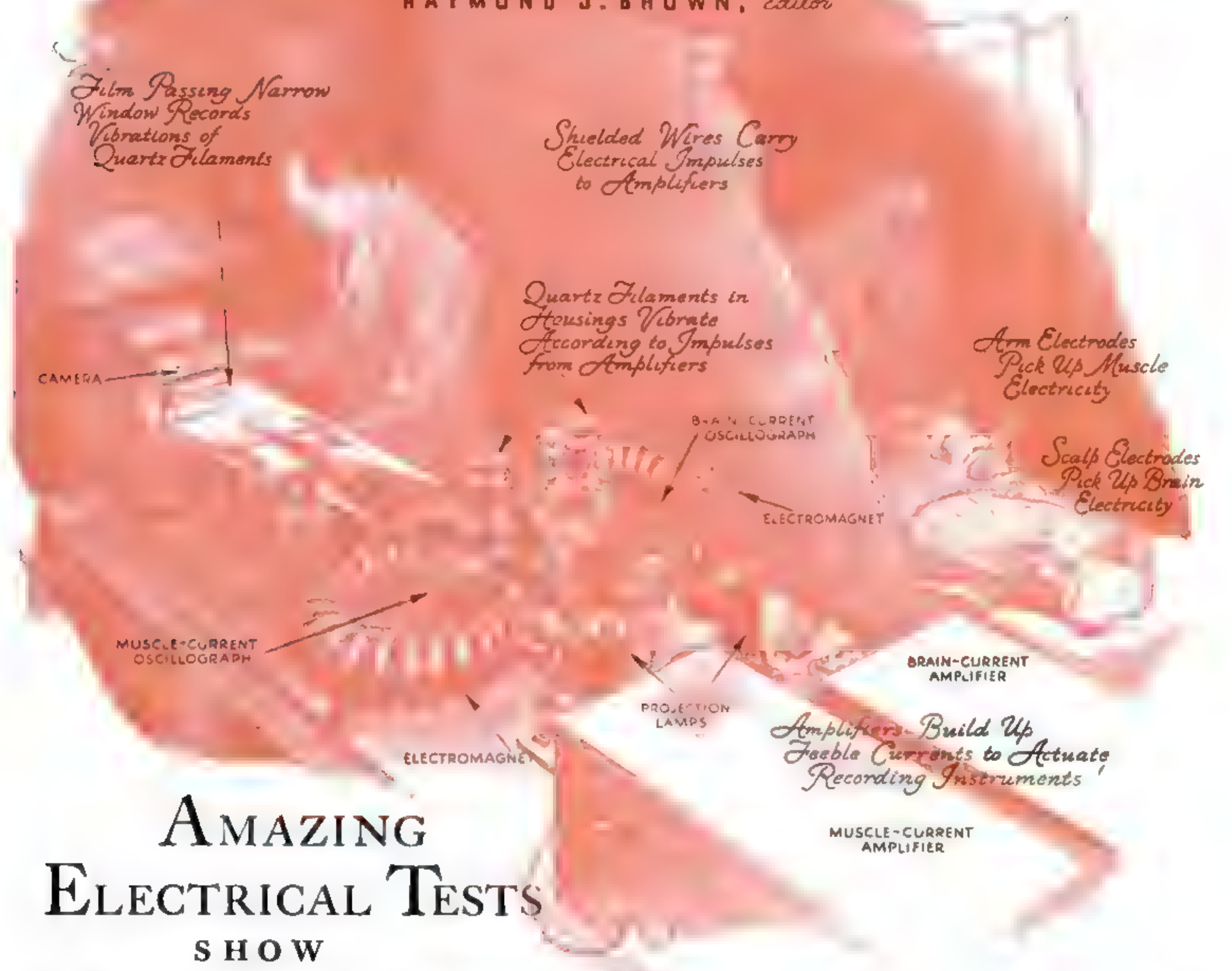
*Available in Master De Luxe models only. Knee-Action, \$20 additional.

The only complete low-priced car
CHEVROLET

A GENERAL MOTORS VALUE



RAYMOND J. BROWN, Editor



Amplifiers Build Up Feeble Currents to Actuate Recording Instruments

How highly sensitive instruments are used to measure infinitesimal currents in the brain, tracing records of dreams and other mental activity upon the film in a camera

AMAZING ELECTRICAL TESTS SHOW

What Happens When You Think

PIONEERS in an amazing new field of research recently traveled to the Loomis Laboratories, Tuxedo Park, N. Y., for the first meeting of its kind in America. The sixty scientists who compared notes are "brain-wave" experts, students of minute, telltale pulsations of electric current that come from the billions of cells in the human brain.

With supersensitive electricity-recording instruments, able to register less than a millionth of a volt of current, they are discovering curious facts about our brains and how they work. Already, these scientists have achieved such exciting feats as

"photographing a dream," watching the electrical pattern made by brain cells in solving a mathematical problem, and witnessing an "electrical storm," piling up in the brain of an epileptic. By discovering rhythms in the varying strengths of these tiny currents, they are working toward a radically new technique in detecting and

diagnosing various ailments of the brain. The first man to tap this feeble flow of power was the German scientist, Fleischle von Marxow. In 1890, with crude and relatively insensitive apparatus, he detected faint electrical impulses passing through the skulls of animals.

For generations before, physiologists had known that tiny currents of electricity accompany the functioning of many parts of the body. If you wink your eye, clench your jaws, take a deep breath—each

By Edwin Teale



A PIONEER IN A NEW RESEARCH

Dr. Louis W. Max in his laboratory at New York University, adjusting the tension of the vibrating quartz filament in his brain-wave recorder

action produces its minute flow of electricity. Time after time, laboratory tests have revealed the connection between electricity and animal life.

When the Nobel Prize winner, Dr. E. D. Adrian, of Cambridge University, England, connected the nerve of a cat's foot to an amplifying set and a galvanometer, an instrument which determines the intensity of an electric current, he found that electricity flowed along the nerve every time he flexed the animal's toe. At Princeton University, the American scientists E. G. Wever and C. W. Bray, performed an even more spectacular test. Disconnecting the auditory nerve of a rabbit from the brain, they attached it by means of electrodes to vacuum tubes and a telephone. Words spoken into the rabbit's ear could be heard over the telephone, proving that ears literally are microphones, turning sound oscillations into electrical impulses. In another laboratory, scientists discovered that the beating heart of an embryo chicken, barely formed within its shell, gave off sufficient current to influence a sensitive galvanometer.

But, most striking of all is the record of a moving mirror in an English apparatus. The heart of a frog was removed and connected to a reflecting galvanometer in which electrical impulses tilted a tiny mirror to deflect a beam of light. Even after all visible signs of life had left the organ, regular pulsations of electric current continued to swing the mirror of the instrument. Hour after hour, in the stillness of the darkened room, the spot of light reflected on the wall maintained its weird and silent oscillations, recording the electric beating of a heart apparently dead!

BY REGISTERING the changes in electric current produced by the human heart on a graph called an electrocardiogram, specialists now diagnose heart ailments. Variations in the curves on these graphs indicate the sources of trouble and aid in prescribing treatment.

For decades after Von Marxow's discovery of brain waves, research in this field awaited new and better equipment. The development of the radio brought it. Vacuum tubes, able to amplify feeble electrical impulses hundreds of thousands of times, make present-day experiments possible.

In 1929, Hans Berger, at the University of Jena, Germany, began the first extensive series of brain-wave investigations. It was the work of this pioneer that led science into a fertile field of research. He carried on his tests under a wide variety of conditions, with subjects hot and cold, relaxed and excited, asleep and under anesthetics. In operating rooms, he placed his electrodes directly on the brain through openings in the skull. He tested scholars and

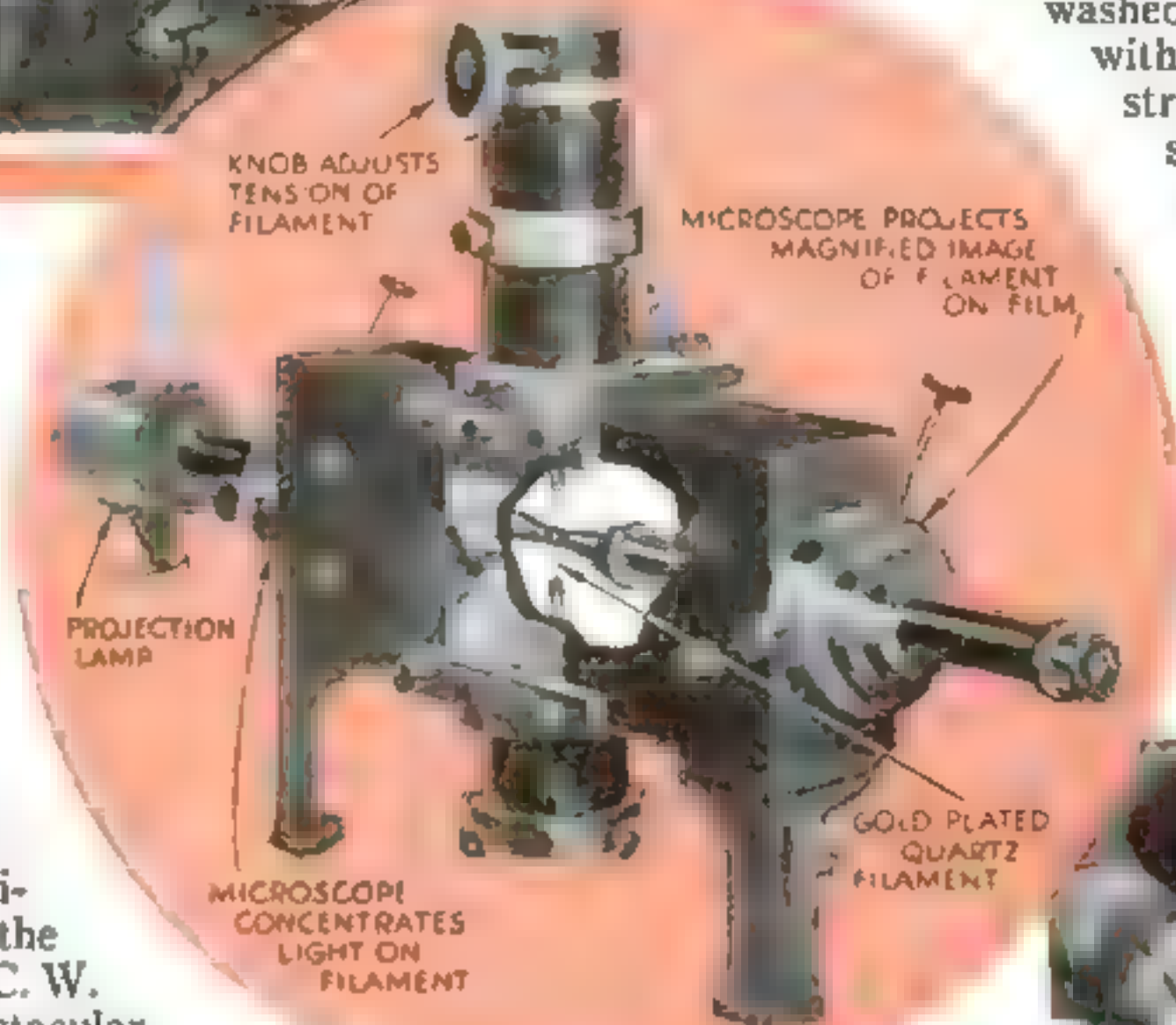
feeble-minded children and, in one experiment, he watched fluctuations in current as a person, deprived of air, lapsed into unconsciousness.

In the United States, such scientists as Hallowell Davis, E. L. Garceau, and A. J. Derbyshire of Harvard, Leonard Carmichael and H. H. Jasper of Brown University, Alfred L. Loomis and Garret Hobart of the Loomis Laboratories, E. Newton Harvey of Princeton, and Louis W. Max, of New York University, have pushed ahead with further researches.

Recently, I spent an afternoon watching Dr. Max at work. Imagine yourself behind the scenes in his basement brain-wave laboratory. Assistants are busy checking batteries, warming electrodes, loading the recording camera. Sometimes, it takes as long as two hours to warm up and adjust the delicate instruments and get everything in readiness for a test.

The subject takes his place on a special cot in a screened-off portion of the laboratory. One arm is carefully scrubbed with soap and water, then washed with alcohol, and finally rubbed with ether to remove all skin oils. Then, strips of cloth, saturated with a salt solution, are wound about the arm to keep the electrodes pressed against the skin at the wrist and on the forearm. A white turban, suggesting a nightcap, contains the silver head electrodes and keeps them in contact with the scalp.

At present, Dr. Max is carrying on a fascinating series of experiments in connection with deaf-mutes. He has discovered that they literally "think with their



This instrument records currents in wavy lines on a moving film. At right, measuring the depth of recorded waves



A picture of a dream. The sudden increase in the strength of the current records the subject's dream of a trip to Coney Island



An assistant in Dr. Max's laboratory adjusting the rubber cap which holds the brain electrodes in contact with the scalp, in preparation for a test

hands." That is, electrical activity in the brain is paralleled by similar activity in the hands, even when the latter fail to show the slightest movement. In subjects having the faculty of speech, this is not true. Instead, they appear to have parallel electrical activity in brain and tongue. This brings up a startling question: Do we think with our brains or with our whole bodies? It is this line of research Dr. Max is now pursuing, and his electrical records indicate that we really think with our whole bodies!

During one of his early experiments, a curious succession of electrical impulses began coming through his instruments. Puzzled, he clipped earphones into the circuit and discovered he was picking up a short-wave broadcast! The horizontal body of the subject was acting as the antenna. Now, subjects are shielded by a coffinlike framework, covered with copper screen, which is placed over them on the cot.

When two assistants have finished lowering this framework into place, the lights snap off. You follow Dr. Max into the dimly lighted instrument room beyond the partition. The faint impulses being picked up by the electrodes run through shielded cables into great, boxed-in amplifiers at the far end of the instrument chamber. There, just as your radio amplifies tiny waves caught by the antenna, rows of vacuum tubes magnify the minute electrical impulses coming from the brain and arm of the subject so that they will actuate recording apparatus.

THE impulses then flow on into two Einthoven oscillographs, super-sensitive galvanometers with gold-plated quartz filaments less than a thousandth of an inch thick. These filaments are suspended in magnetic fields produced by two giant, horse-shoe-shaped electromagnets. The amplified electrical impulses coming from the brain and arm of the subject flow through the fine quartz threads and cause them to vibrate according to the strength of the current.

It is the shadows of these vibrating strings cast by powerful projection lamps that write the records of the varying electric currents on the film of the recording camera. Just now, the shutter of the camera is closed and the two fine, dark lines pulsate back and forth on a ruled observing screen. The camera, behind the screen, can be set in action in an instant to make a permanent record of any portion of the test.

For nearly twenty minutes, the dark lines vibrate in erratic fashion. Then the brain line settles into a steady rhythmic fluctuation. The subject is asleep. Slumber is usually chosen for tests because then the brain and body conditions are most constant.

On more than a score of occasions, Dr. Max has recorded dreams on his strips of films. In one, the subject imagined himself at Coney Island and in another he was engaged in a fist fight at a barbecue. These wavy lines form the world's first picture of a dream. And they shed light on a long-debated question in psychology: How long does a dream last?

This work interested me particularly because of an experience I had some years ago. I dreamed of



Dr. Hallowell Davis and associates at Harvard University making a brain-wave test with a magnetic recorder, seen in oval, developed by the Western Union Telegraph Company



wrestling with a burglar in a dark kitchen and knocking a tin pan from a hook in the course of the struggle. I awoke with the sound of a pan striking the floor reverberating in my ears. A friend of mine, a Harvard psychologist, later told me that I had dreamed the whole struggle in a flash, during the instant I was waking up after hearing the pan accidentally fall from the hook. Dreams, psychologists then agreed, were compressed into a second or two of time. Now, Dr. Max's records of electrical activity in the brain indicate that dreams may last for two and a half minutes or more.

How do scientists know the pulsations they get really come from the brain?

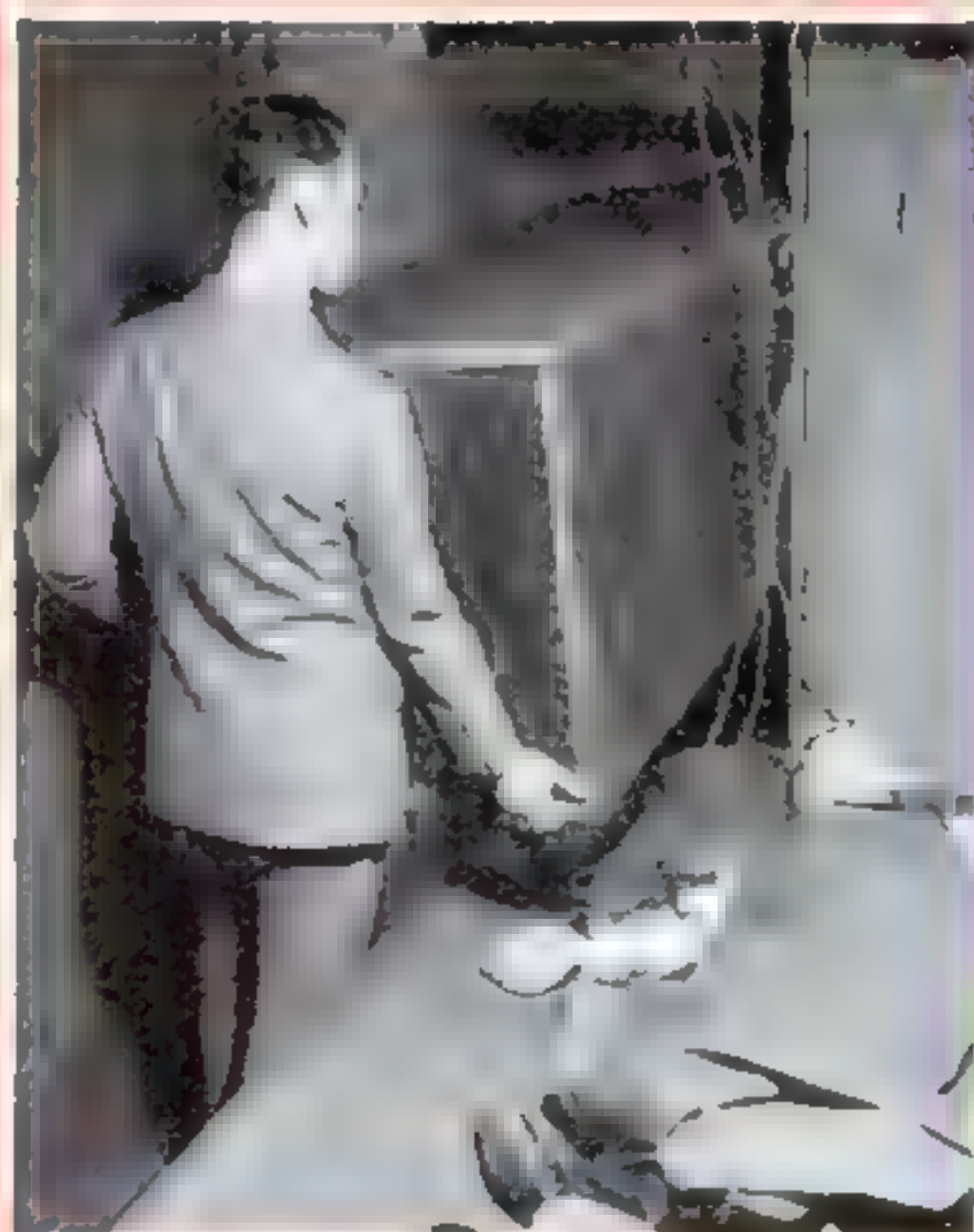
There are several reasons, Dr. Max explains. In the first place, the form and rhythm of pulsations from muscles and from the brain are noticeably different to the eye of the expert. Furthermore, when Berger, the German experimenter, placed his electrodes directly on the brain in an operating room, he got stronger currents than when they were on the outside of the skull. This would not have been so if the current came from anywhere except the brain itself.

During his researches, Berger also discovered that brain waves fall into two general groups, the alpha rhythm, with approximately ten fluctuations a second, and the beta rhythm, with twenty or more a second. The character of these electrical pulsations remains about the same for a given subject day after day. Eventually, the German scientist hopes to discover the normal wave, just as heart specialists have done in the case of the electrocardiogram, thus enabling him to diagnose brain ills electrically.

Along this line, research men at Harvard have found that epilepsy can be detected through the abnormal brain waves given off by the afflicted person. Seizures, their tests indicate, are nerve storms which result in a great piling up of electrical charges. During an epileptic fit, the flow of electricity from the brain increases 3,000 percent over that given off when the brain is relaxed and normal.

When a person faints, on the other hand, brain waves slow down to from three to five a second. But, the voltage rises to more than double the normal level.

In Dr. Max's laboratory, it has been discovered that the harder the brain works the more electricity is recorded from the arms of his deaf-mute subjects. He has found that doing a difficult mathematical problem will produce more of this body current than doing an easy one and that memorizing a sentence results in a greater output (*Continued on page 117*)



A framework covered with copper screen being placed over a subject to prevent his body from acting as an antenna and picking up radio programs

Uncle Sam Fights a New

A Mexican peddler arrested by California narcotic inspectors, with a bale of marijuana, or Indian hemp. Cigarettes are made from leaves and flowers



WIPING OUT A CITY-GROWN PATCH OF MARIJUANA

A police emergency squad eradicating a patch of the drug-producing plants from a vacant lot in Astoria, N. Y. Its resemblance to common weeds often makes hemp hard to identify

ONE DAY last summer, a squad of men suddenly descended upon a vacant lot in a large eastern city. Attacking a patch of innocent-looking weeds, they first burned the stalks down to the ground and then spread chemicals to make sure that every vestige of life in the roots was destroyed.

The weed was marijuana—better known as Indian hemp—and within that one vacant lot there was enough, if converted into cigarettes or “reefers” and peddled through underground channels, to be the potential cause of half a dozen murders and other brutal crimes.

Its destruction was but one of the skirmishes along a nation-wide front in the almost unheralded war being waged on this insidious drug. Federal, state, and city officials are engaged right now in combating what was described by Secretary of State Hull in a report to the League of Nations as “one of the major police problems of America.” They are carrying on the fight, against enormous handicaps, in practically every state in the Union.

Within the past decade, marijuana smoking has ceased to be a Mexican Border problem and has become a national menace. Another ten years of its phenomenal spread and the suppression of opium, heroin, cocaine, and similar drugs will seem like child's play in comparison. A strange combination of circumstances is responsible for its rapid sweep through the nation.

The plant is nothing new. It has been



Cigarette-rolling machines like this, intended for tobacco, are commonly used by marijuana smokers

in this country ever since the earliest settlers in the New England colonies brought hemp seed to grow the plants from which rope fiber was, and still is, obtained. For several centuries, Indian hemp was cultivated and used in America for legitimate purposes. The fact that the American plant was exactly the same as that from which hashish was obtained in the Orient was not generally known. It emerged from the limbo of forgotten drugs only within the past few years.

Today, the small towns of the nation are being invaded by the drug, while the large cities already have vast numbers of smokers. It is being sold to school children in more than one state. Marijuana cigarettes, or “reefers,” are peddled at fifteen cents to several dollars each by men who either raise the drug in back yards or in carefully concealed plots in the country, or gather it along the roadside. Before Pennsylvania passed laws against it, the chief of Philadelphia County detectives declared that whenever any particularly horrible crime was committed—and especially one pointing to perversion—his of-

ficers searched first in marijuana dens and questioned marijuana smokers for suspects.

The curious history of how the Indian hemp plant, *Cannabis Indica* or *Cannabis sativa*, reached such unsavory prominence in America offers an example of how a natural product, innocent in itself, can remain unnoticed and not used for evil purposes for centuries, only to plunge into sudden disrepute. It also reveals why its use is a problem and how the average citizen can help stamp it out.

The New England colonists used hemp for the manufacture of rope and for homespun cloth. Soon it was being grown in the Virginia and Pennsylvania colonies, and it appeared at an early date in the Kentucky settlements. Its spread westward to Missouri followed and, at various times, hemp was grown in Illinois, Indiana, Nebraska, Iowa, California, and other states.

It was employed solely for its utilitarian purposes, chief of which was, of course, the making of rope. Practically all the rope and twine used in America until the introduction of abaca, or Manila fiber, came from the hemp plant.

The date of the introduction of hemp in Mexico is not known; but it probably arrived with the earliest Spanish settlers.

Thus, the stage was set for its skyrocket climb within recent years to become the foremost menace to life, health, and morals in the list of drugs used in America.

In all the years of its early use in America, it was not smoked. The colonists had tobacco, and weren't interested in experimenting with hemp. But somebody—who either knew that hashish sometimes is burned instead of eaten, and the fumes inhaled, or who lacked tobacco and tried hemp as a substitute—learned that it had

Drug Menace...

MARIJUANA



How an Innocent-Looking Plant, a Roadside Weed In Many States, Presents A Grave Narcotic Problem

By WILLIAM WOLF

powerful narcotic effects when smoked. This probably occurred in Mexico.

Suddenly, the nation awoke to the fact that it had a major drug problem on its hands. Marijuana smoking, which was confined at first to Mexico and the Southwestern States, started to spread. And, worst of all, the plant from which the narcotic came not only could be grown anywhere, but actually was growing wild in many states!

Early this year, a house was raided in a small New Jersey town, and marijuana worth \$6,000 was seized. The person arrested had in his possession a large quantity of the dried and prepared weed. He confessed that it was grown on a small



Some of the marijuana captured in a raid. The cigarettes often cost several dollars each

plot of ground belonging to the house he rented.

The commercial production of marijuana is as simple as that—a field is planted and the weed grows. It needs no special preparation before being sold as a drug, other than drying the leaves and flowers. The only thing that led to this arrest was a quarrel with somebody who knew what the "patch of weeds" was and told police officials about the secret back-yard crop.

Federal authorities reported last fall at the end of the growing season that large acreages of *Cannabis sativa* were destroyed in Pennsylvania, New York, Ohio, California, and Georgia. At the same time, evidence of its widespread cultivation was contained in the additional report that, within a few days' time, investigations and seizures were made at points as widely separated as Rochester, N. Y., Fremont, Ohio, Sacramento, Calif., and Columbus, Ga.

Because it was circulated so generally in this nation's early history, marijuana now is a roadside weed in many sections of the country.

For that reason, Fed-

eral authorities regard it as a puzzling problem. Furthermore, over fifteen states failed to adopt the uniform narcotic-drugs act under which the Federal authorities could prosecute peddlers and growers of the weed. Some of these states only forbid the importation of marijuana; and, since it grows anywhere, such laws obviously are useless.

Where it is grown for sale as "dope," considerable ingenuity is expended in concealing the fields containing it. In the Ohio case reported by Federal officials, a large stand of Indian hemp was hidden by surrounding cornfields. That is a favorite trick of growers, to hide the marijuana with higher-growing crops.

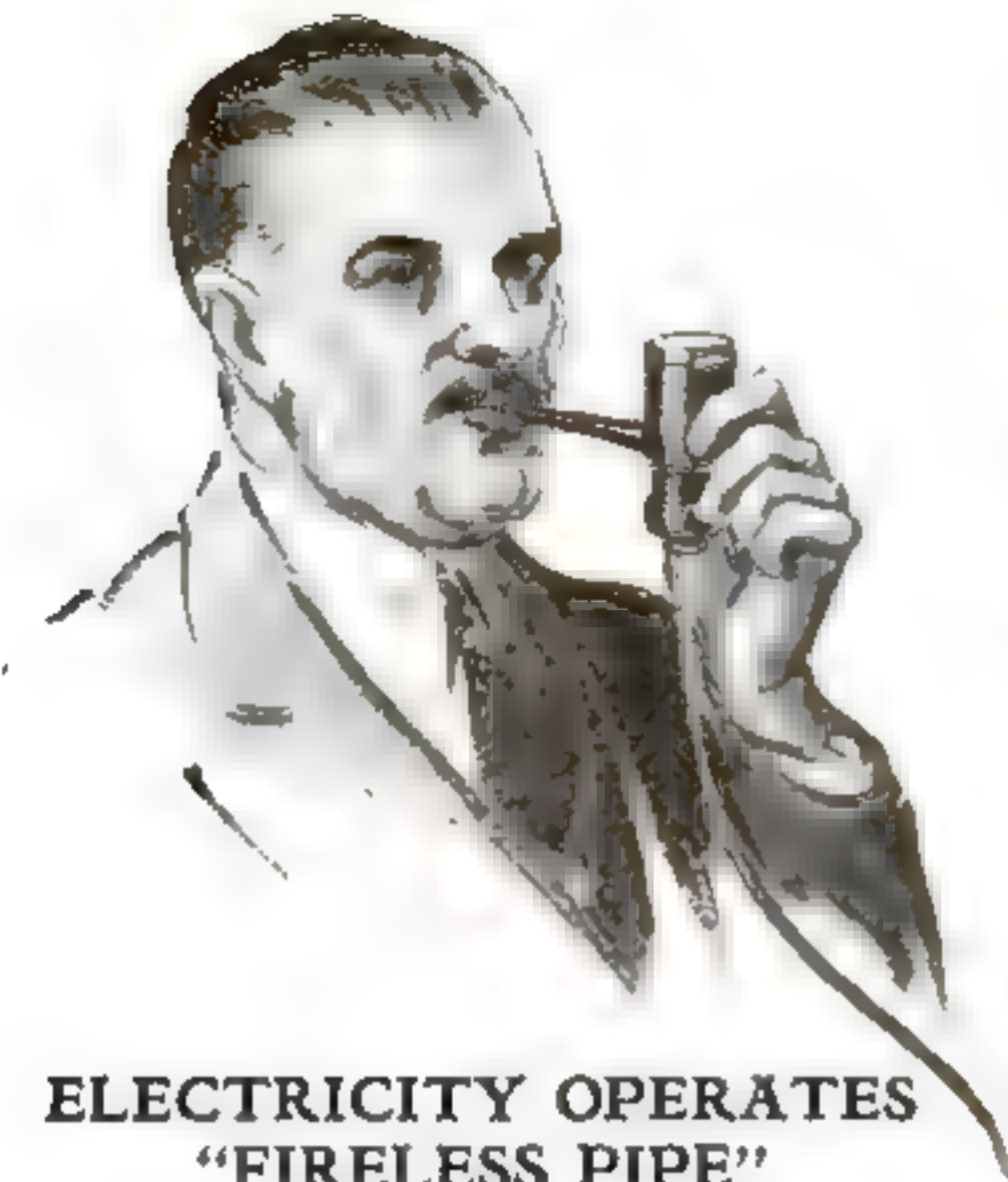
The average citizen can help stamp out marijuana by reporting to the proper authorities any suspicious growth hidden by corn, alfalfa, or similar crops. The weed grows four to eight feet or more in height, has a sticky surface when touched, and gives off a strong narcotic odor. When grown for its fiber, it is cut before reaching full growth; but when intended for illegal uses, it is allowed to blossom, since it is the flowering tops, the leaves, and the small stems that are gathered and dried for smoking.

The plant has erect, branching, and angular stems, while the leaves are alternate and opposite on long, lax footstalks. The leaves have sawlike edges and may be odd or even in number, but usually about eight leaves are in one group.

What are the (Continued on page 119)



A patch of Indian hemp found growing in the side yard of a San Francisco home. The occupant of the house was arrested



ELECTRICITY OPERATES "FIRELESS PIPE"

A "FIRELESS PIPE," operated by electricity, has been devised by a Toronto, Canada, physician, who maintains that it prevents the inhalation of harmful carbon monoxide and reduces fire hazard by eliminating the use of matches. Tobacco is volatilized by a heating element and the fumes are breathed in the usual way. One

model is shaped like a standard pipe; another, built into a table lamp, has tubes for several smokers at once.

Above, individual electric pipe. A model for several smokers, built into a table lamp, is seen at right



FIRST AMERICAN MAIL ROCKET TESTED

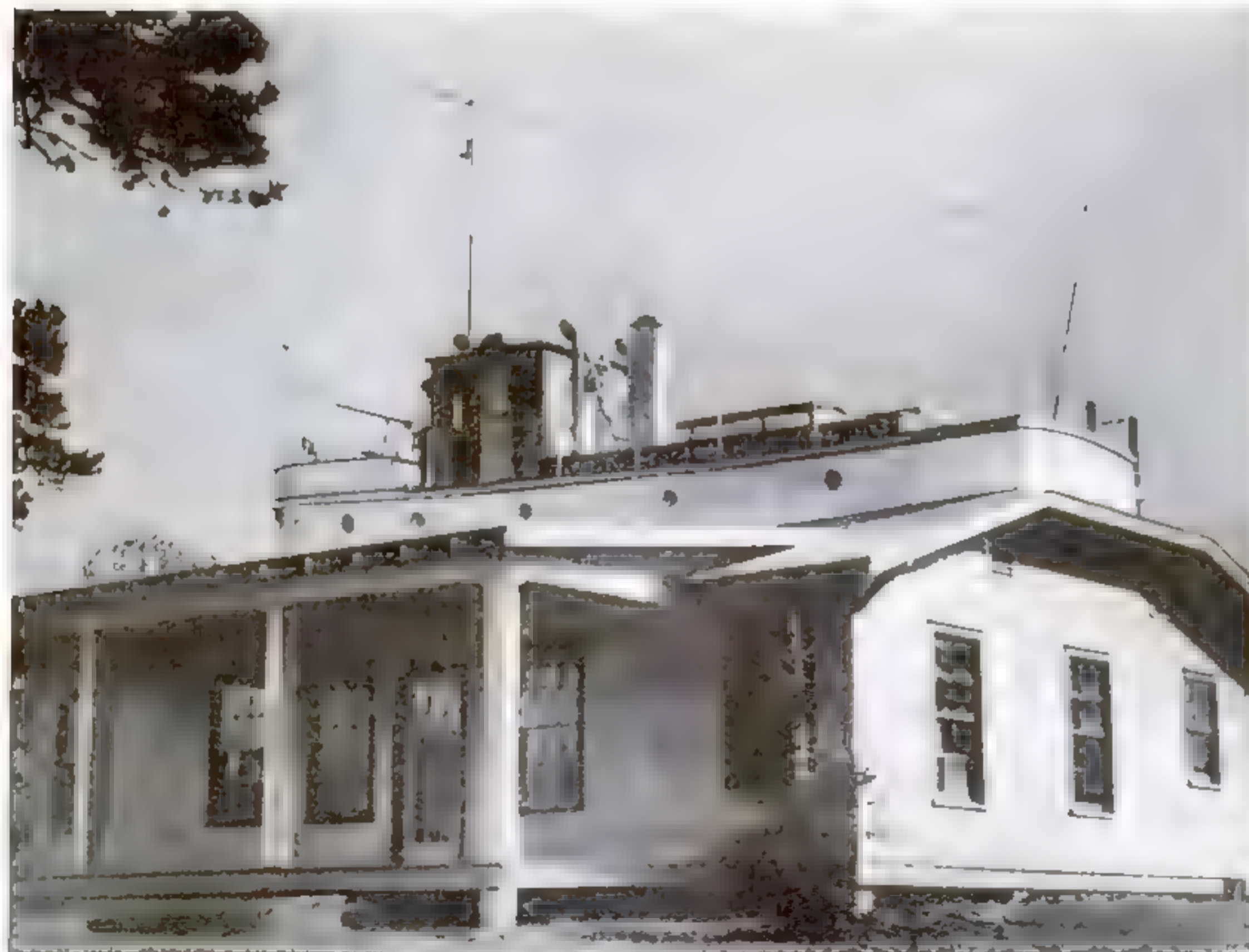
UNIQUE among the sackfuls of letters that the mail men deliver daily, the first missive to reach **POPULAR SCIENCE MONTHLY** by rocket air mail was received by this magazine a few weeks ago. Resplendent with red, black, and purple decorations and a special green stamp depicting a rocket in flight, it was a part of the pioneer American air-mail cargo of its kind. An experimental rocket-powered glider fired from an inclined runway at Greenwood Lake, N. Y., veered erratically, but carried the cargo to its intended des-

tinuation at Hewitt, N. J., just across the state line, where the postmaster retrieved the letters and sped them to the persons to whom they were addressed.



Experimental rocket glider carrying mail, leaving its runway at Greenwood Lake, N. Y., for the test flight to Hewitt, N. J. Inset shows a letter which was part of the trial rocket-mail cargo

SEA SCOUTS GO SAILING IN HOUSE-TOP TRAINING SHIP



PERCHED high and dry atop a one-story building, hundreds of miles from the nearest ocean, a boat recently christened at Fort Oglethorpe, Ga., will serve as a training base and headquarters for a group of Sea Scouts. The oddly placed craft is modeled after a Coast Guard cutter. Though it will never sail anywhere, it is reported to be complete in every detail. Its equipment includes radio, lifeboats, cannon, and riding lights. On its decks, the scouts will receive practice in navigation, seamanship, and other duties of real deep-water sailors.

3000-YEAR-OLD RAZORS FOUND

BRONZE razors 3,000 years old have been discovered near Vienna, Austria, during excavations for a road. Although they are damaged by corrosion, experts believe that when new they were the equal of the best razors made today.

Fins on Engine's Stack Deflect Smoke

A STREAMLINE steam locomotive recently completed by the Pennsylvania Railroad has unique horizontal fins mounted around the smokestack to deflect smoke upward and away from both engine and cars. Similar to an airplane wing in design, the smoke deflector counteracts the tendency of conventional locomotives to create low-pressure areas which suck the smoke downward along the train when it is traveling at high speed. Railroad experts state that the new device will not only protect passengers from the annoyance of coal smoke and dust, but will also insure high visibility for the engineer at all times.



A new, completely streamline steam locomotive developed by the Pennsylvania Railroad for high-speed through passenger service. Note the novel smoke deflector.

Constructed on aerodynamic principles, these fins force smoke upward away from cab and coaches.

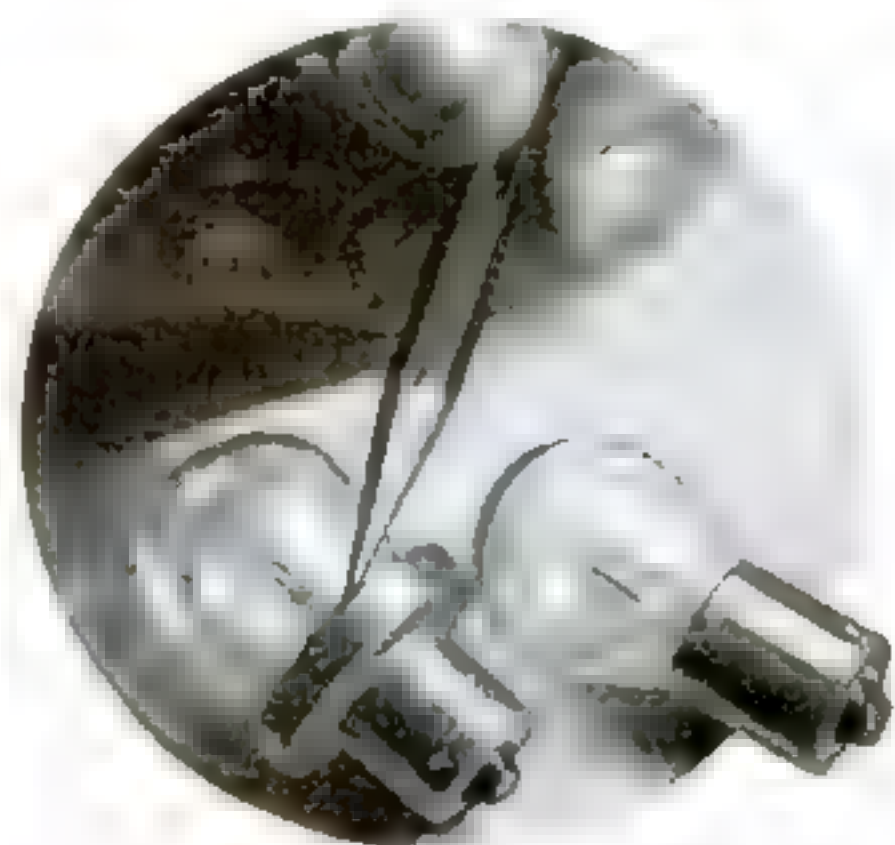


NO REST FOR SLUMBER-TEST SUBJECTS

BLASTS from a loudspeaker make the night hideous for volunteers engaged in sleep tests at the University of Chicago. A subject is put to bed, and while he is asleep the noise maker is set off. As soon as he hears the sound, he presses a button that sounds a buzzer in an adjoining room, to let an observer know he is awake. The time lapse shows how soundly he has been sleeping. The tests are expected to show what conditions are requisite to a good night's sleep.



Experimenters using clocks, loudspeaker, and other apparatus to determine how soundly a subject has been sleeping.



STOP LIGHT FLICKERS

DESIGNED for brake-operated stop lights, a new automobile bulb flickers intermittently while the current is on. Flashed on and off by a self-contained current interrupter, the light quickly attracts attention. The new bulb is shown above.

BABY PLANET WHIZZES BY EARTH

A BABY planet named Anteros, discovered as it recently whizzed by only 1,500,000 miles away, is now our nearest known celestial neighbor except the moon. Astronomers declare a collision with the earth some day is unlikely but nevertheless possible. Like another minor planet or planetoid discovered in 1932, which approaches within 2,500,000 miles of the earth (P.S.M., Aug., '32, p. 21), Anteros is a stray from a cluster traveling beyond the orbit of Mars.

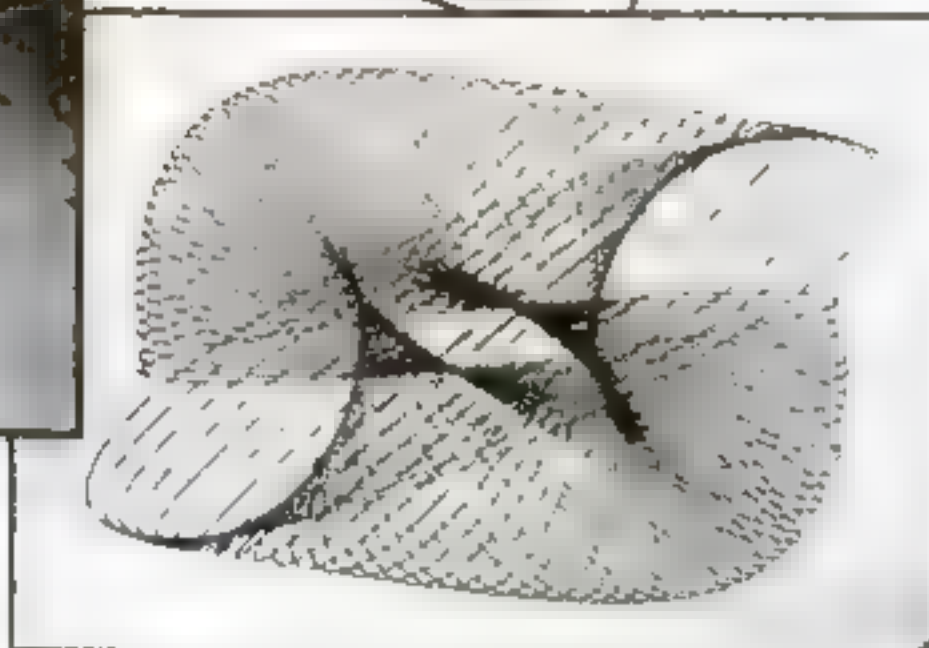
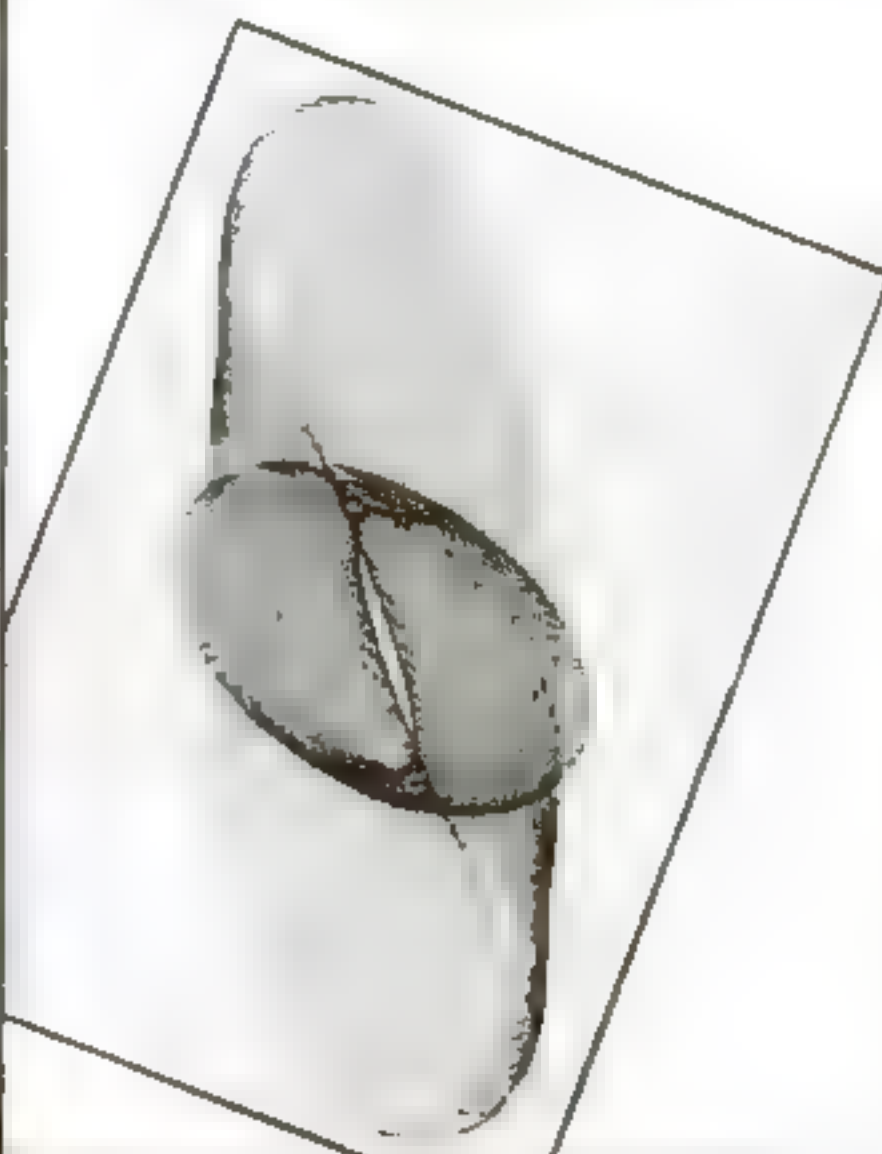


How new planetoid's one-third-mile diameter compares with works of man.



Milan Fiske demonstrating his "precision harmonograph." Swinging pendulums, seen under the tripods, produce complicated geometrical designs like those at right.

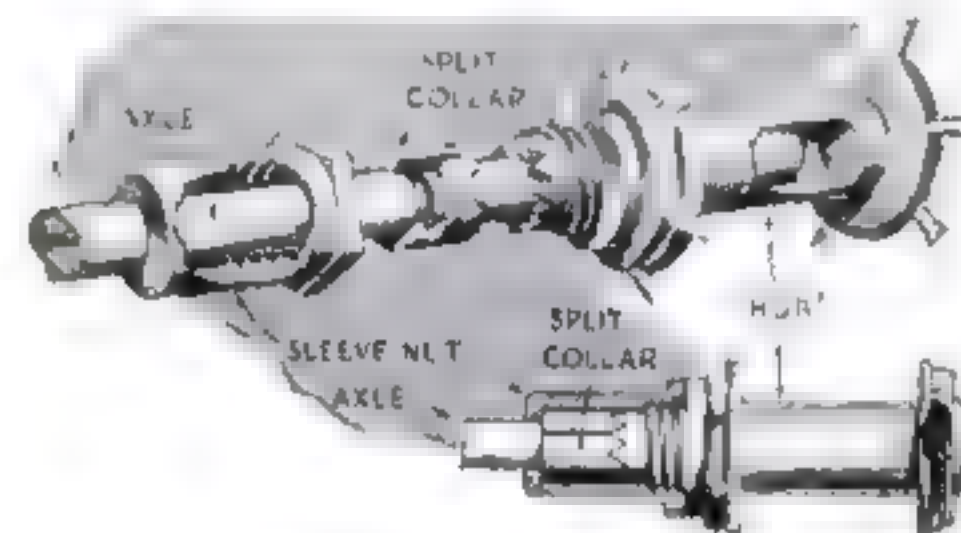
Pendulums "Draw" Novel Designs



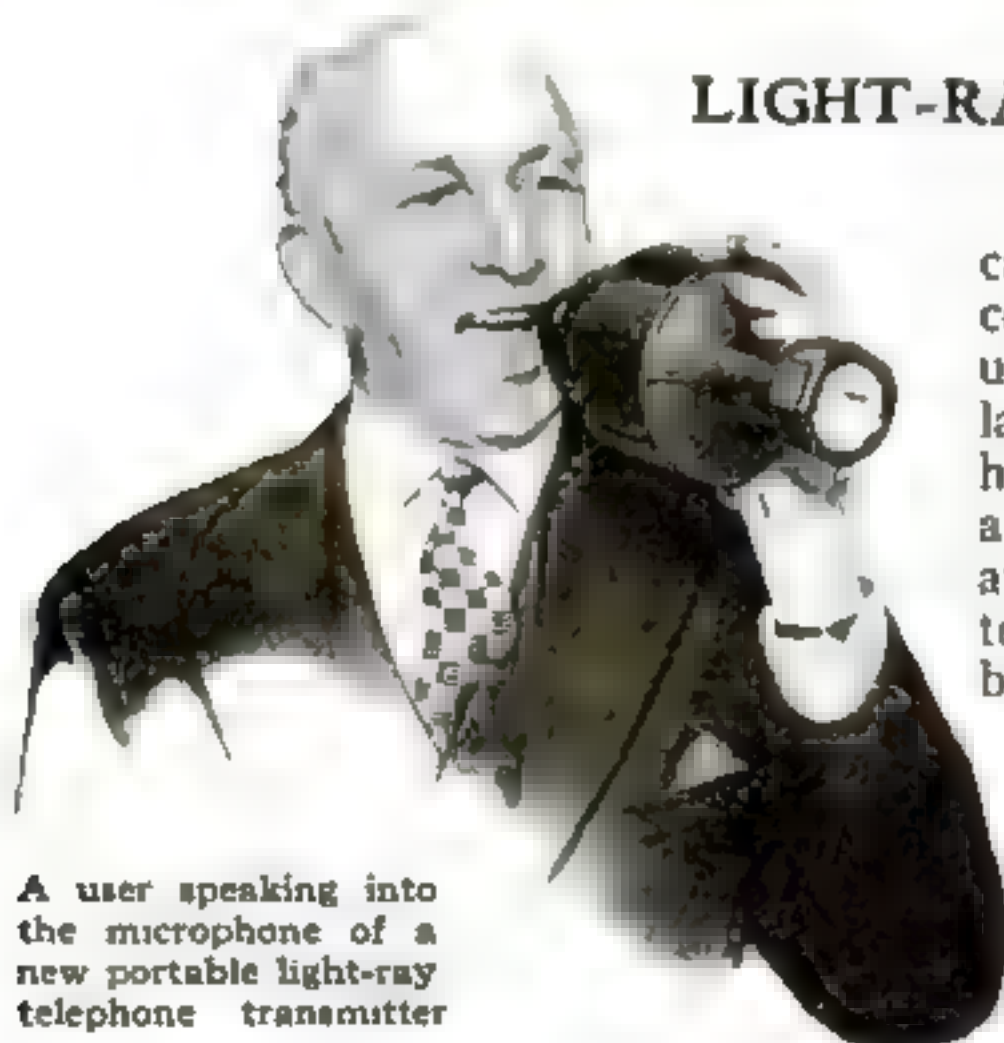
INTRICATE geometrical designs, many of striking beauty, are produced by a curious instrument constructed by Milan Fiske, junior student at Beloit College, Beloit, Wis., and known as a precision harmonograph. The unusual device, which its youthful builder believes may be the only one of its kind in the country operating on similar principles, aids in the mathematical study of compound harmonic motions. A platform, mounted on a universal joint, is rocked by a pendulum while a fountain pen at the end of a three-foot arm, also supported upon a universal joint, is given an independent motion by a second pendulum. This traces a design, called a harmonogram, upon a sheet of paper attached to the rocking platform. By swinging the pendulums in various ways, Fiske estimates, as many as 10,000,000 different patterns of curves may be produced.

SIMPLE WHEEL MOUNTING

A NEW method of fastening a wheel to an axle dispenses with springs, screws, and cotter pins. A split collar, ridged on the inside, snaps into place upon a notched axle, and teeth at its outer edge engage similar teeth on the wheel hub, so that collar and hub will turn as a unit. The assembly is held together by a threaded sleeve. It is declared suitable for the wheels of baby carriages and other light vehicles.



Diagrams show the parts of a new wheel mounting for small vehicles, separate (top) and assembled (bottom).



A user speaking into the microphone of a new portable light-ray telephone transmitter.

LIGHT-RAY PHONE IS PORTABLE

TALKING over a ray of light is made practical by a portable light-beam telephone recently demonstrated in England. When the user speaks into a microphone, a flash-light lamp flickers in response to the vibrations of his voice. The modulated beam is picked up by a photo-electric cell at the receiving station and reproduced as speech. While light-beam telephony is not new, the latest apparatus is believed to be the most compact yet devised.

SMALL-BORE AMMUNITION HAS HIGH BULLET SPEED

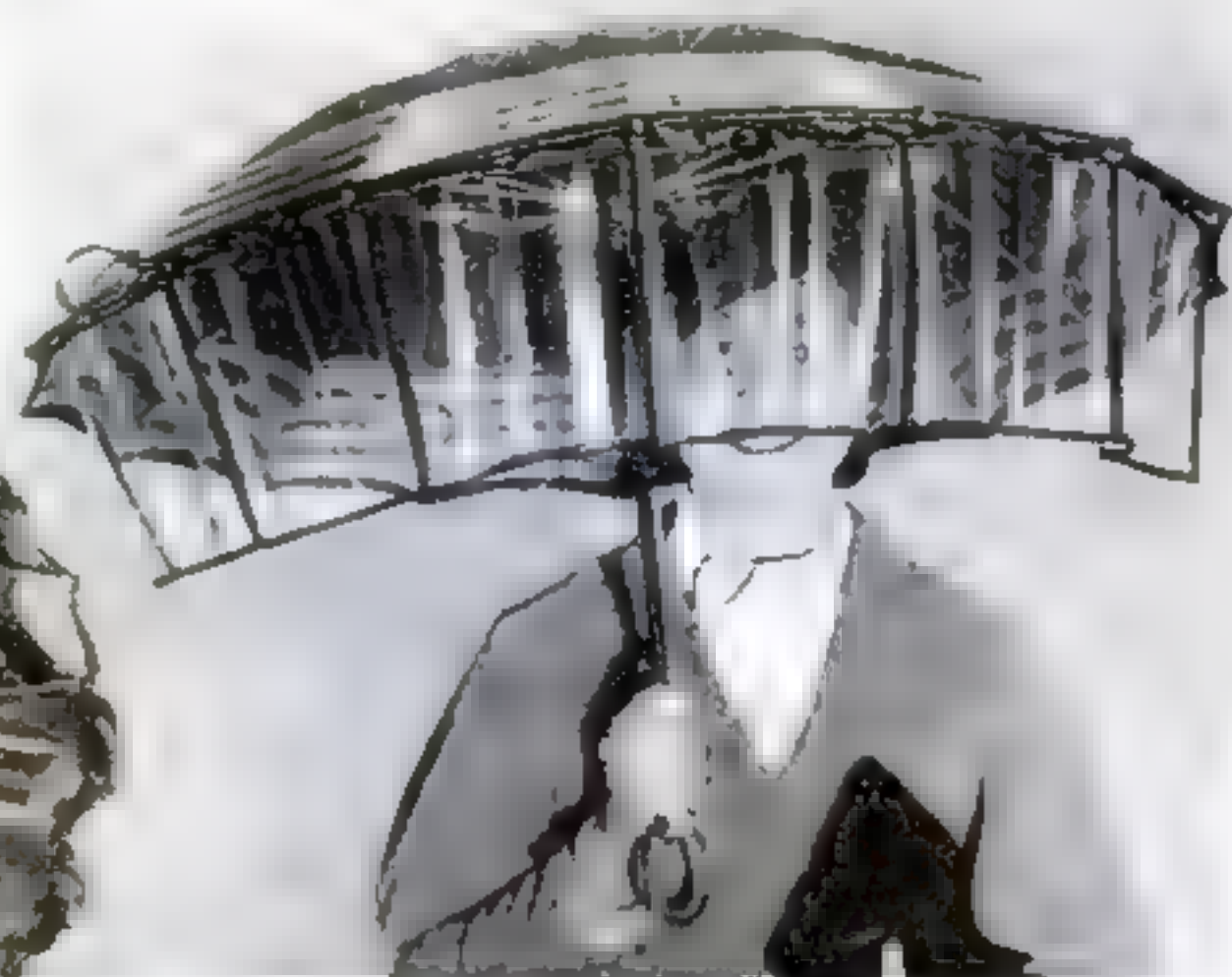
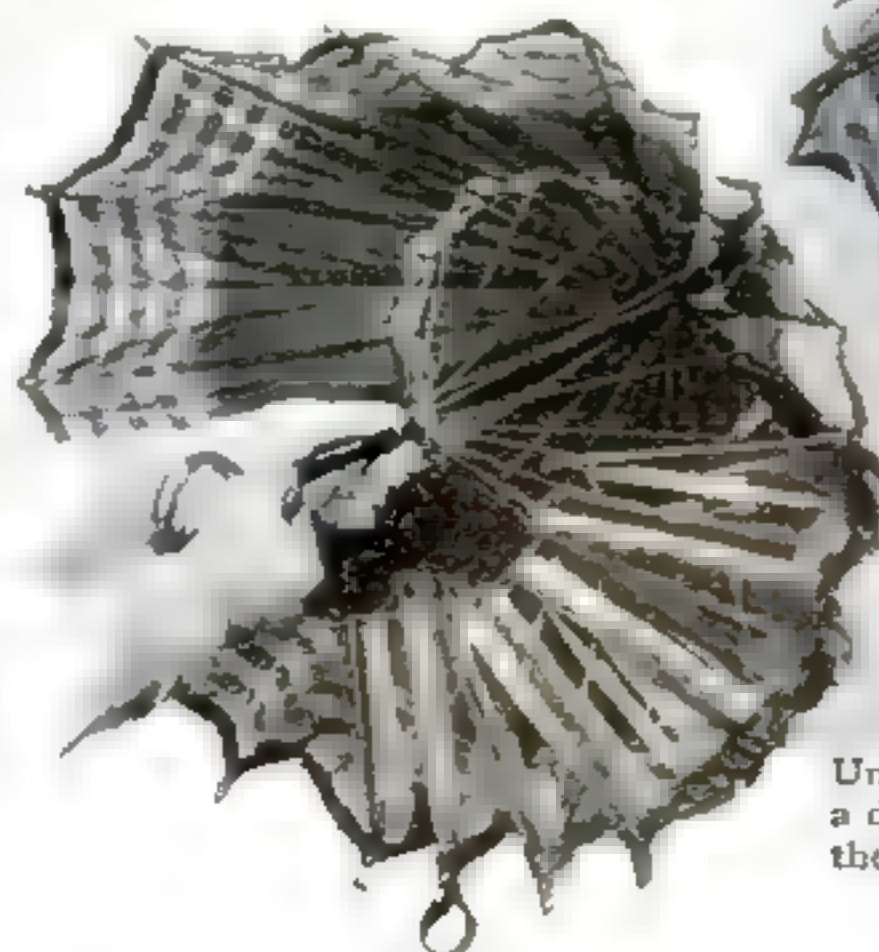


New high-speed cartridge, right, compared with an ordinary .22 long-rifle cartridge.

SAID to be the fastest rifle cartridge so far produced commercially, a type of .220 caliber ammunition now on the market for special small-bore rifles starts a bullet on its way at the amazing speed of 4,140 feet a second, or forty-seven miles a minute! Since the drop of a bullet at this muzzle velocity is negligible, distance calculations are eliminated, and quick and accurate shots at game are therefore made possible.

WINDSHIELD FOLDS INSIDE UMBRELLA

AN UMBRELLA with a built-in windshield, recently patented, protects the user from driving rain but allows him a clear view ahead. Made of sections of transparent celluloid, the windshield folds inside the umbrella when not in use and automatically drops down into place when it is opened. Metal rods hinged to the umbrella ribs hold the shield in a rigid position.



Umbrella with transparent shield in place for use in a driving rain. The photograph at the left shows how the sections fold inside the cover when not in use.



EXPLORER SEES OLDEST SKYSCRAPERS

LIKE a mirage seen by a thirst-crazed traveler, the fabulous skyscrapers of Shibam, twelve and more stories high, rise from the midst of the desert in Southern Arabia. Only a few outsiders have ever set eyes upon this legendary city. One of the few, and the first to return with actual photographs to back up tales of its wonders, is Hans Helfritz, German explorer. His experiences are related and illustrated in his book, "Land without Shade," just published by the Robert M. McBride Company, through whose courtesy a remarkable view of the skyline of Shibam is reproduced above.

The white towers, he reports, date from

the time of the Queen of Sheba. Built of mud-and-straw bricks that have hardened to granitelike consistency, they have survived the centuries and are still inhabited. Dwellers live in the elaborately furnished and decorated upper stories, to which cemented clay staircases give access. The lower floors are windowless, for protection against frequent raids of hostile tribes. Save for this fact and the absence of glass, which is unknown in Shibam, the skyscrapers outwardly show startling similarity to modern buildings. The city has a population of about 6,000 and is the most ancient and important in the forbidden province of Hadramaut.

STAMP GAUGE SPOTS DEFECTS

WITH a stamp gauge just placed on the market, collectors can quickly locate irregularities and defects, and accurately measure their exact position within a fraction of a millimeter. Made from clear celluloid, the accessory resembles a piece of transparent graph paper; it is marked off into one-millimeter squares by a network of crisscross lines. The lower left corner of the gauge is centered over the corresponding corner of a stamp, and the position of the defect noted in relation to the numbered vertical and horizontal lines. The gauge also shows the exact size of a stamp in millimeters.

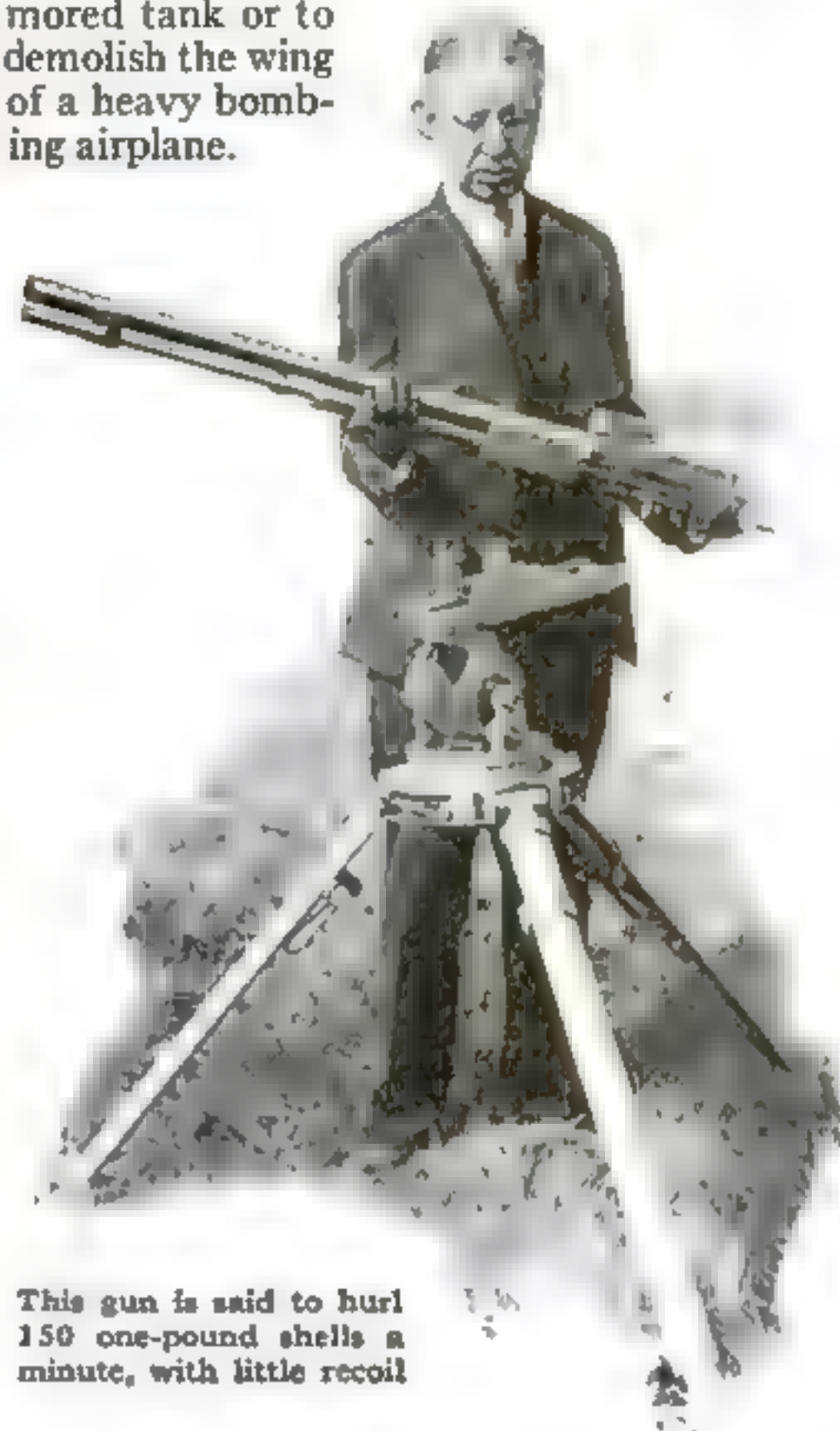


STAMP DEFECT GAUGE

Celluloid gauge with one-millimeter squares, for locating flaws in stamps

"KICKLESS" MYSTERY GUN IS TESTED BY ARMY

A NEW "kickless" mystery gun undergoing Army and Navy tests is reported to hurl one-pound, high-explosive shells at the rate of 150 a minute. Recoil is so slight, it is said, that water will not spill from a glass balanced on the barrel during fire. Each shell contains a charge powerful enough to shatter an armored tank or to demolish the wing of a heavy bombing airplane.



This gun is said to hurl 150 one-pound shells a minute, with little recoil

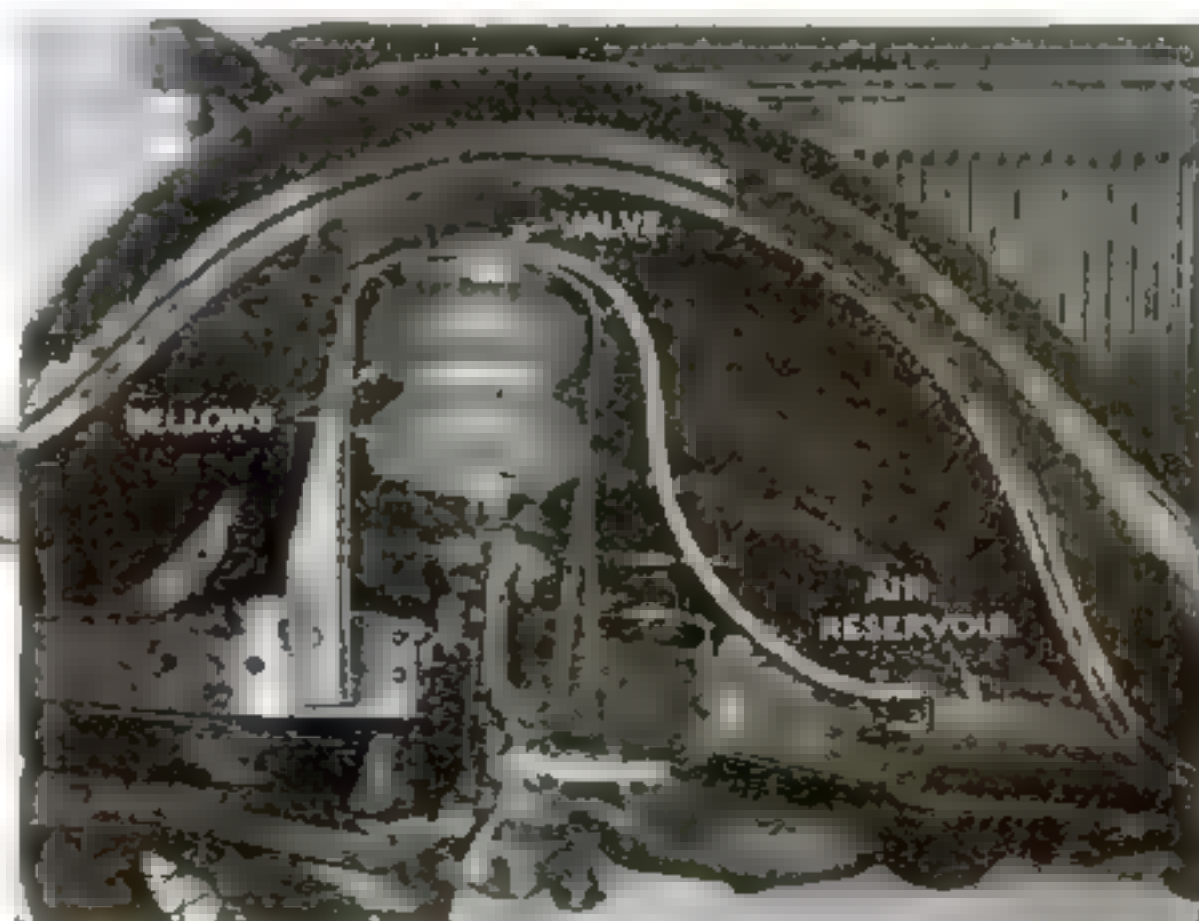
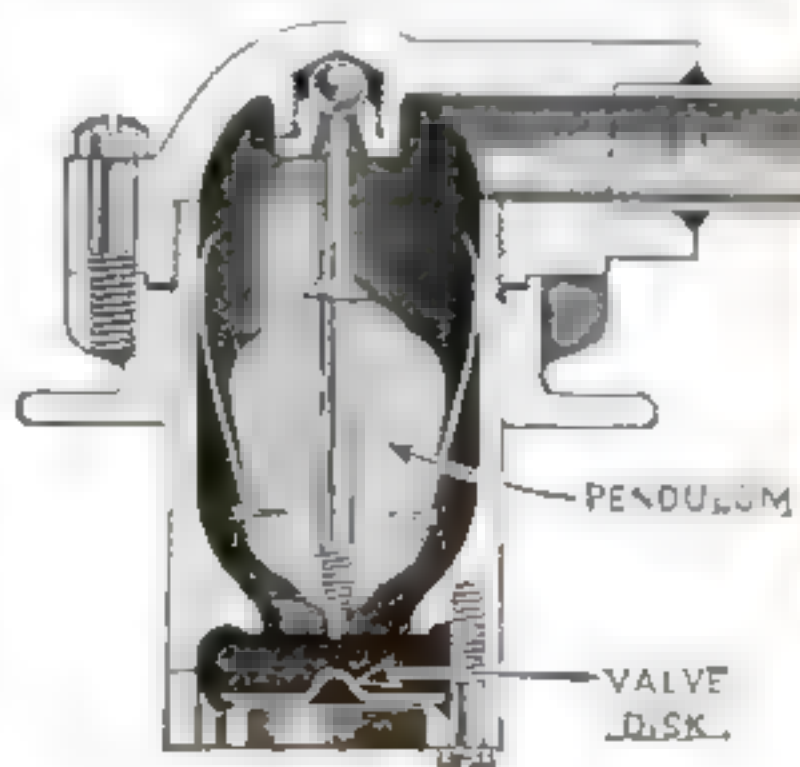
SWITCH CAN'T WEAR OUT

COMpletely silent in operation, a wall-type electric switch recently developed has no moving parts to wear out. As the switch knob is flicked, a small quantity of mercury sealed in a hydrogen-filled compartment shifts from side to side to make or break the electrical contact. Tested in a laboratory for two years, one of these mercury switches is said to have turned a 200-watt lamp on and off 65,000,000 times without failing and without requiring repairs. Small and compact, the switch can be adapted to any switching operation.

CAR RIDES ON CUSHIONS OF AIR

RIDING on air is literally made possible by the development of air springs for automobiles. A bellows of rubberized fabric, mounted at each wheel between axle and frame, communicates through a special valve with an air reservoir. When the car hits a bump, the air in the bellows and reservoir cushions the shock. Recoil is suppressed by a valve disk, which checks the backrush of air forced from the bellows into the reservoir by the impact. To lessen body roll in rounding curves, and "nosing down" when brakes are applied suddenly, a pendulum in the valve swings out of the way and allows the valve disk to seal the connection to the reservoir, confining the air in the bellows and giving the temporary effect of stiffer springs when it is needed.

The drawing below shows details of the specially designed pendulum valve that adjusts the flow of air to lessen the body roll and "nosing down" in braking



Air-spring mechanism installed on an automobile. The rubberized-fabric bellows, connected with an air reservoir, compresses and expands to give easy riding

Home-Grown Lions Are

EIGHTEEN SNARLING BEASTS BRED IN



Deaf since infancy, this performer was trained by motions of whip and hand

By
**JOHN E.
LODGE**

ON YOUR own seats, children," spoke the trainer in a flat, even voice, which carried the ring of authority to eighteen half-grown African lions ranged in a semicircle against the back of the big, steel-barred training arena. "Quiet. Front. Sit down, Abdullah."

Abdullah, third son born in captivity to a lioness who likewise never had known life on the veldt or plain, parted his lips in a sneer and slapped menacingly at the stick pointed toward his throat.

"Abdullah," repeated William Foix, standing on the ground only six feet from the lion's face, "sit down. You'll get used to this business, fellow."

But Abdullah had not yet accustomed his 350 pounds to the hard feel of the tiny platform. He replied to the stern command by leaping without warning, carrying the trainer down under his powerful body.

For a moment it looked to us outside the bars as though the man were in for a bad time. Unarmed except for the long wooden stick and a heavy whip, he fell on his left side against the bars which at once prevented his escape and kept helpers from coming to his rescue. The lion sank his teeth into the trainer's flesh.

swept his powerful forepaws across his body. At the same instant Foix drove the heavy butt of the whip against Abdullah's nose. The lion leaped backward in a complete somersault, leaving the trainer to nurse eleven deep scratches and incisions which, for the moment, he left unheeded.

"Hah," cried the trainer as he pulled himself up. "you start new things when we're not ready. Now get up there!"

He walked slowly toward the lion, motioning with whip and forked stick.

before leaving the arena to attend his wounds. "They're like children. They think because they were once petted, they can get away with anything. Animals born in the wilds are more difficult at the beginning, but they acquire confidence more quickly and learn that nothing will harm them."

Foix did not fall before the onslaught of a wild lion. Abdullah was born in captivity and reared on goat's milk which he drank from a bottle. As a cub he had been petted. Four others of the eighteen solemn males were raised on milk drunk from bottles. All were born of captive mothers on Gay's Lion Farm at El Monte, Calif., where I had gone to learn why bottle-reared babies become the most treacherous animal actors to step into an arena, and how a veteran of many years' experience trains them for exacting performances before the public.

They were not yet finished actors when I saw them. For six months the eighteen lions had been



William Foix teaches Abdullah, one of the most unruly of his eighteen charges, to cross his forelegs

"Up! Up!" Foix shouted, insistently.

Abdullah raced once around the arena, leaped nimbly onto his pedestal, fourth from the right end of the line, spun quickly to face the trainer, and sat down. Paying no further attention to the quick-tempered brute, Foix turned to another, on the opposite side of the arena.

"On your seat, Romeo," he commanded, motioning the lion up. "Front, Toby. Ben Turpin, sit down. All right, Monarch, Nero, Brutus. Over there, Sultan, don't start anything, Prince, you'll get along all right. Apollo, Mars, Tarzan, Pasha, Rassow. You're nice children. Keep quiet, Menelik, Caesar, Rex, Leo, Abdullah, you devil, be a good child."

After addressing each by name, the trainer stepped to the bars through which I had observed the brief encounter. "Too many hands have touched these fellows," he explained,

THE Daily Routine

This fixed schedule is the one to which lions destined to be actors must adhere

8:00 Receive fresh water in their cages.

8:15 Are turned out of the cages to play in the sunshine

9:00 Go into the arena for a three hour rehearsal of old tricks and practice of new stunts.

12:00 Are sent into runway outside the arena to rest in sun or play. If the day is hot, they receive a second drink of water.

3:00 Go through a general rehearsal for one hour. No new tricks at this time.

4:00 Feeding time in the cages. Each lion gets a chunk of fresh horse meat weighing from twelve to sixteen pounds, depending upon the lion's appetite and needs. On Mondays, no meat is provided. Instead, each lion receives a share of a mixture made from five gallons of milk and three dozen eggs. This removes from their systems any small bones they may have swallowed. Three times each week a dose of cod-liver oil is given with their meat.

5:00 More fresh water

6:00 Bedtime—for a sleep that lasts ten to twelve hours. During the night, they occasionally awake to roar or to turn over and try the other side

World's Toughest Actors

CAPTIVITY PREPARE FOR CIRCUS CAREERS



The pyramid, a stock trick of lion acts, as performed by Foix's "class." Toby is rebellious

undergoing daily training, trying out like athletes seeking places on a baseball or track team. Some stretched their bodies farther than others, and qualified for top positions on the pyramid. One—he was deaf, by the way—displayed proficiency in walking on a rolling barrel. Another crossed his feet on command. Three lithe youngsters jumped a wide gap between pedestals gracefully and with ease. Each unwittingly underwent tests of intelligence and physical adaptability which marked him for a particular job.

There were no dummies in this group. The entire stock of 223 lions and lionesses on the farm had been examined before eighteen males, all about the same size, were selected. These, together with four understudies, were herded into one of the several pens on the farm. There they were carefully studied. Charles Gay, owner of the farm, and Foix noted the set of the eye, slope of forehead, distance across the nose, degree of physical perfection and reaction to strange noises. As the lions paced about their cages, the men watched closely to learn whether any habitually tried to hook passers-by with their claws, and observed their fierceness in at-

tacking their daily rations of food.

After satisfying themselves that all candidates met the composite test satisfactorily, Foix began to introduce them singly into the arena. There he observed



It took six months of training to teach Rassow to make this leap

Charles Gay, proprietor of the lion farm, holding a six-months-old cub while it takes milk from a nursing bottle



each animal at close quarters and gave the lion an opportunity in turn to study him. He carried with him a revolver loaded with blank cartridges, a whip, and a long stick made of oak. Of these, the stick has proved his most formidable weapon for its point, quickly subdues a charging animal and drives him into retreat.

For the better part of two days, I sat outside the iron-barred arena observing the experienced teacher of wild animals as he moved cautiously among these home-grown monarchs who had never experienced the wild life of nature. Now he walked with apparent nonchalance, turning his back on a group of solemn faces;

again he passed others, guarding carefully against a sudden attack, making comments for my benefit as casually as though he were engaged in nothing more serious than teaching a puppy to roll over on the living-room rug.

"Never break a lion's spirit," he shouted, raising his voice to get it above the deep-throated roars coming from some of the other lions housed on the farm.

I silently agreed I would never so tempt fate.

"You cannot terrify a lion, anyway, if he doesn't want to be frightened," he continued. "Lion training is largely a matter of confidence. Mutual confidence. They're like humans. These faces are as different to me as black and white."

I looked around the semicircle, taking in all the dozen and a half animals. They looked like so many peas in a pod to me. Yet to *(Continued on page 122)*

Mine Explosions

*Unique Underground Laboratory
Reenacts Disasters of the Past
To Save Lives and Property*

By WALTER E. BURTON



Coal dust, stirred up by compressed air and ignited by an electric spark, provided this spectacular open-air blast at the experimental mine at Bruceton, Pa.

AT A control board in a building perched on a Pennsylvania hillside, a man reached up and grasped the handle of an electric switch. After glancing about to see that everything was ready, he pulled the handle sharply downward. Instantly, the hum of whirring motors filled the room. But, overshadowing that, an ominous rumble made the building tremble. Outside, a crowd of spectators held their breath.

Suddenly the hillside some 400 feet away belched a cloud of black smoke interwoven with streaking flame. Before the wide-eyed spectators had time to realize what was taking place, this roaring jinni had grown into a mountainous monster of smoke and fire that hurled itself across the valley and rebounded from the opposite hillside. A mile away, windows rattled and shattered.

Uncle Sam had fired his cannonlike mine again!

As the cloud of black smoke drifted away, the mining engineers and other coal men who had been watching the demonstration got to their feet, for this was the concluding act in a program of fireworks that rivaled anything they ever had seen. But this crowd lacked some of the careless gayety that most spectators of fireworks show. Although they had been entertained, they realized that behind this and other spectacular stunts they had witnessed that day, there is a story of how thousands of lives and millions of dollars' worth of property have been saved during the past quarter century—a story that recalled to some of the old-timers painful experiences of earlier mining days.

The giant explosion was the climax of one of many demonstrations given before

coal experts at the experimental coal mine operated by the U. S. Bureau of Mines. It is located thirteen miles southwest of Pittsburgh, Pa., near the tiny hamlet of Bruceton.

This coal mine, where the production of coal is a minor matter, is located on a seventy-seven-acre tract of land containing about thirty-eight acres of coal in a bed five feet thick—part of a vein that runs almost unbroken for 200 miles through Pennsylvania and West Virginia.

Reaching the mine property and driving through the concrete entrance archway, the visitor comes first to a group of buildings which house the explosive-testing division. Then, continuing, he reaches the portals of the mine itself. Scattered about are a number of queer-looking structures.

There are, for instance, several 100-foot steel "galleries," one of them looking very much like an elongated railway tank car minus its wheels. These are employed for testing the safety of explosives and the explosive properties of gases and coal dust. And then there is a building such as you



Mine car equipped with trough for coal dust, compressed-air hose, and spark gap to create artificial mine explosions as required for tests



AT THE PIT MOUTH. This photograph shows the first burst of flame from the mine portal after experimenters had set off a charge only a short distance within the entry

Made to Order

TO DEMONSTRATE
SAFETY METHODS

would have difficulty in finding at other mines. It is a "coal mill," where lumps of coal are ground into fine powder.

Another of the buildings, besides containing the offices of Superintendent H. C. Howarth and his assistants, has a room that is the "brains" of the experimental mine. It contains a collection of instruments used for making records of various things that happen when a mine explosion takes place; a panel to which all electric circuits in the mine are connected, and a battery of switches for controlling electrical equipment and instruments in the mine. It is from this room that the mine is "fired," much as if it were a subterranean cannon, when a coal-dust demonstration or test is being made.

Entering the mine, the visitor finds that it contains a collection of equipment as strange as that above ground—steel-armored recesses in the walls, where pressure-measuring instruments can be placed, hydraulic jacks for testing the crushing strength of coal, and so on.

The mine itself consists of two parallel entries 1,308 feet long, with side entries leading to special testing chambers and to a series of conventional mine rooms. This mine has been constructed so that it is similar to scores of small commercial workings in the Pittsburgh district.

A series of disastrous mine explosions led Uncle Sam to become an experimental miner. In 1906, 1,100 men were killed when the Courrières mine in France blew up. As if this were a signal, there followed an epidemic of similar mine disasters in England and the United States. These were climaxed by a great explosion in the Monongah mine in West Virginia, which killed 361 men. Today, such explosions are rare, thanks largely to the experimental mine and the engineers who run it.

Before my visit to the experimental mine, I had a vague notion of what coal dust is. But it remained for Superintendent Howarth to show, very impressively, what this coal dust can do.

He explained first that when coal is reduced to a powdered form and then thrown

into the air so that the particles are suspended in a cloudlike mass, it becomes an explosive of great power. Even with modern mining equipment and practices, this creating of dust clouds cannot always be avoided. A train of mine cars may jump the track and upset, creating a dense cloud. The use of the wrong kind of explosive may do the same thing, and make matters worse by igniting the cloud. Once ignited, the coal dust acts as if it were so much blasting powder.

"I'll show you one way coal dust sometimes is ignited in mines," Howarth said. "Dynamite, you know, can be used for mud-capped or 'bulldozing' shots, to break large rocks. That is, the explosive is placed against the rock and covered with some material that will direct the force of the explosion towards the rock. Mud, sand, and even wet or dry coal dust have been used. I'll show you what happens when there is a lot of coal dust around."

First, one of Howarth's assistants laid a stick of dynamite in an open space on the ground. Wires were run from the detonating cap to a small magneto held by another man a safe distance away. The magneto armature was spun to fire the shot. A puff of dust, a few pebbles tossed into the air, and that was all.

Then another stick of dynamite was placed in the same posi- (Continued on page 92)



Apparatus used to study the vertical compressibility of coal. Such tests determine the proper thickness of pillars



Miners spreading coal dust on shelves in preparation for a trial explosion. It will be scattered by rushing gases and ignited by the flames as the blast spreads



AN ARTIFICIAL MINE

Pillars of smoke mark the progress of the blast through a 100-foot steel gallery after a charge of black powder ignites the coal dust placed there for the trial

Photos Courtesy of
U. S. Bureau of Mines

Submarine Tractor Speeds Search for Gold

SUBMARINE and tractor are combined in a novel underwater vehicle designed and constructed by a California salvage expert to locate a gold-laden river steamer, wrecked twenty-three years ago in San Francisco Bay. Looking like a small boiler mounted between two endless treads, the odd one-man craft is eight feet long and has an inside diameter of twenty inches. It is lowered to the bottom of the bay by means of a derrick on the deck of a motor-boat tender. Current for the tractor's two electric motors and powerful searchlight is supplied through a cable connected to generators on the tender. The operator, lying flat inside the machine, looks out through a thick glass porthole in one end to maneuver the craft along the bed of the bay. A telephone communication system keeps him in constant touch with his assistants on the surface. The inventor claims that the submarine tractor will operate with perfect safety at a depth of 600 feet.



Odd underwater vehicle on the deck of its motor-boat tender. It is being used in an effort to locate the wreck of a sunken treasure ship



The operator inside the submarine tractor ready to have the front end bolted in place

ENVELOPE SEALS WITHOUT LICKING

NEW "lickless" envelopes for letters require no moistening. When an auxiliary gummed flap forming part of the back of the envelope is turned upward and the regular flap is pressed down to seal the letter, the two gummed surfaces adhere so firmly to each other that they cannot be separated without tearing.



Envelope with auxiliary flap which is turned over for moistureless sealing

WIND-TUNNEL DIRIGIBLE TESTED ON WHEELS

MOUNTED on a standard truck chassis for test purposes, an odd "vacuum-rocket" craft recently invented may be the forerunner of an entirely new type of dirigible. Air sucked in through a funnel-like opening and drawn through a tunnel in the center of the vehicle, is expelled at the rear at a tremendous speed, creating a

rocketlike propelling force. A dirigible constructed under this principle would have a hollow nose with a central tunnel leading through the bag. Propellers would draw in air ahead of the ship, creating a partial vacuum and reducing air resistance.



The inventor of a new principle of dirigible propulsion, with an experimental model mounted on a truck chassis. At left, a side view of the unusual vehicle



Folding house setup.
Low jacks support it

FOUR-ROOM HOUSE FOLDS INTO TRAILER

COMPACT and light enough to be drawn behind an automobile, a mobile house designed by a Detroit, Mich., inventor enables the owner to set up housekeeping wherever he wishes. Folded for traveling, the dwelling occupies a space only sixteen feet long and less than seven feet wide, and is towed as a trailer. At its destination the house is uncoupled and set up on jacks, expanding to form a complete residence with a living room twenty feet long and fourteen feet wide. It also boasts two bedrooms and a fully equipped kitchen. Electric lights are part of the furnishings.



The house folded for traveling and attached to a car as a trailer. Above, a corner of the completely equipped kitchen. There are also two bedrooms and a living room

NECK STRAP IS SUPPORT FOR CAMERA

LONGER exposures than would ordinarily be possible, with a miniature camera held in the hands, are permitted by a one-legged support with a strap that encircles the wearer's neck. The photographer's arms form the other two legs of a "tripod" to steady the camera.



Miniature camera with one-legged support

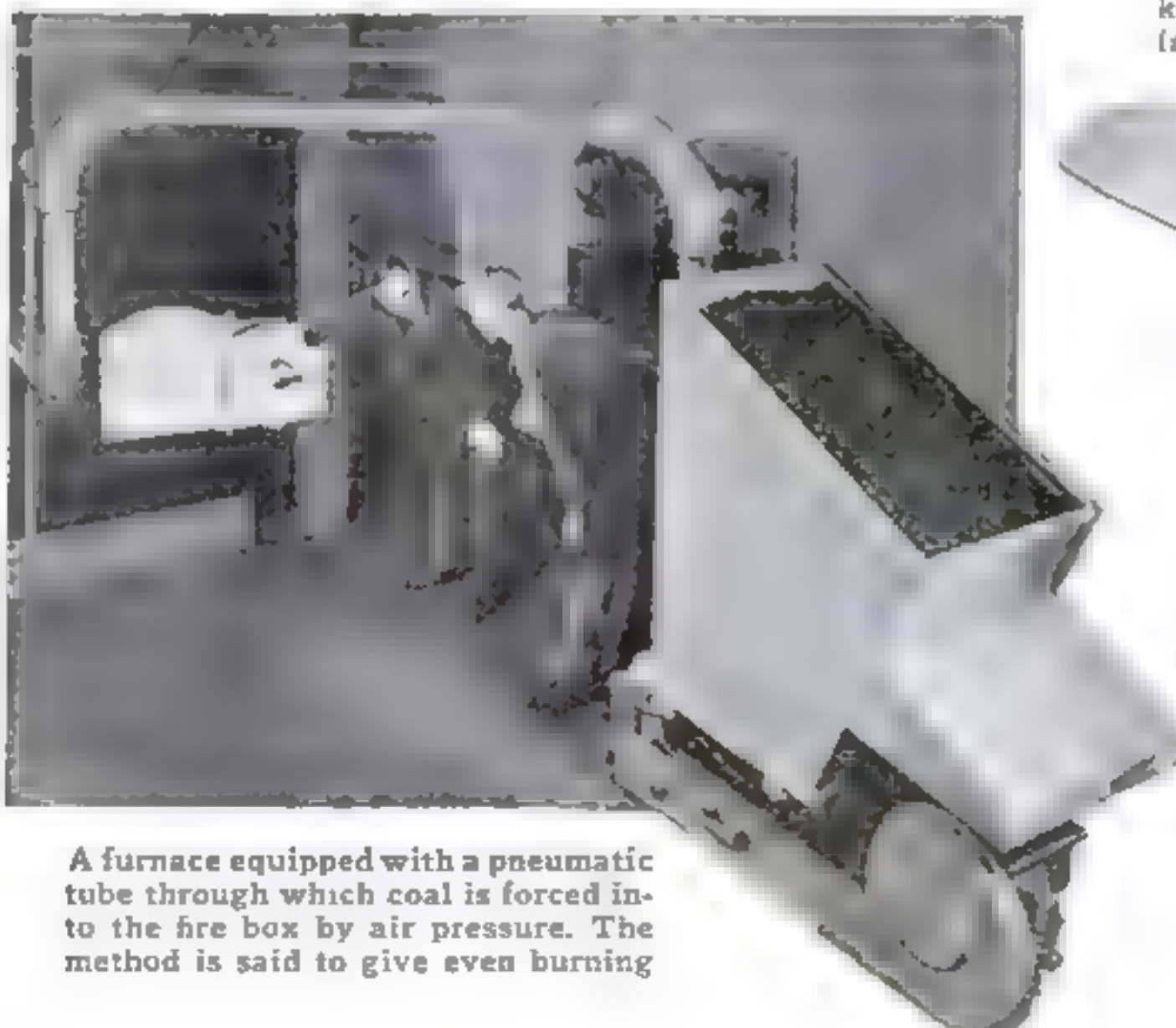
UMBRELLA HAS TELESCOPE IN HANDLE

AN UMBRELLA with a spyglass in its handle is a recent creation of a British inventor. The combination enables racegoers and other sport fans to forearm themselves against inclement weather, and to take along a glass to watch distant events, without the burden of two separate articles to carry. Another British innovation is an umbrella with a built-in miniature camera which, despite its unusual mounting, is declared to be a fully practical instrument. The two novelties in rainy-day equipment are illustrated in the photograph at the right.



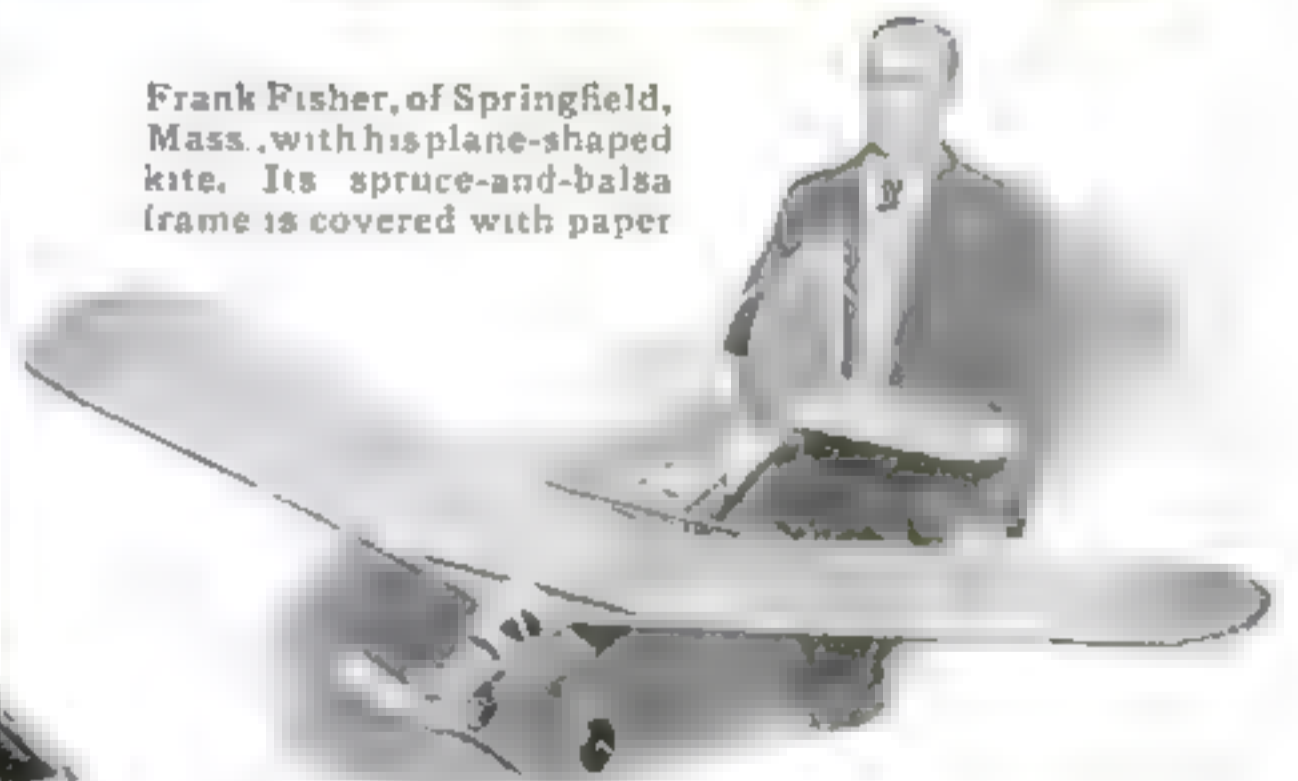
PNEUMATIC TUBE STOKES FURNACE

BY SHOOTING coal through a pneumatic tube, a stoker just perfected for industrial furnaces dispenses with mechanical conveyors. A high-velocity stream of air provides sufficient motive force to raise lumps of fuel up to one and a half inches in size, and "float" them from a feed magazine into the fire box. Issuing from a discharge nozzle within the furnace, the larger pieces of coal drop to the grate and are evenly distributed, while fine particles burn in the air. This is said to promote better combustion.



A furnace equipped with a pneumatic tube through which coal is forced into the fire box by air pressure. The method is said to give even burning

Frank Fisher, of Springfield, Mass., with his plane-shaped kite. Its spruce-and-balsa frame is covered with paper



KITE MADE LIKE A PLANE

VIEWED from the ground while in flight, an unusual kite constructed by a Springfield, Mass., craftsman looks like an airplane passing overhead. It is patterned after an Army pursuit craft and has a wing spread of six feet. Its spruce-and-balsa frame is covered with light, tough paper.

Back Seat of Car Makes a Comfortable Bed



Cut-away view of car with bed made up. The foot extends into the luggage compartment. At right, close-up showing how the seat cushions provide a foundation for the bedding.



SEDANS of two popular makes are now offered with back seats which can be converted into comfortable beds more than six feet long and over four feet wide. Cushions have been so designed that they can be moved forward and laid flat like Pullman sleeping-car seats to form a foundation for bedding. The foot of the improvised bed extends into the rear luggage compartment, baggage being transferred to the front seat for the night. When not in use as a bed, the car interior

bears no trace of its dual function. The car appears to be a standard, conventionally equipped automobile. The convertible car is expected to prove popular with fishermen, hunters, campers, and tourists who want sleeping comfort without the expense of hotel accommodations or the inconvenience of transporting bulky tents and camping equipment. The car also provides the means of visiting and staying in distant regions which have no hotel or tourist accommodations.



A seat cushion in use as a bench for an outdoor table. Auto campers thus have both bed and board.

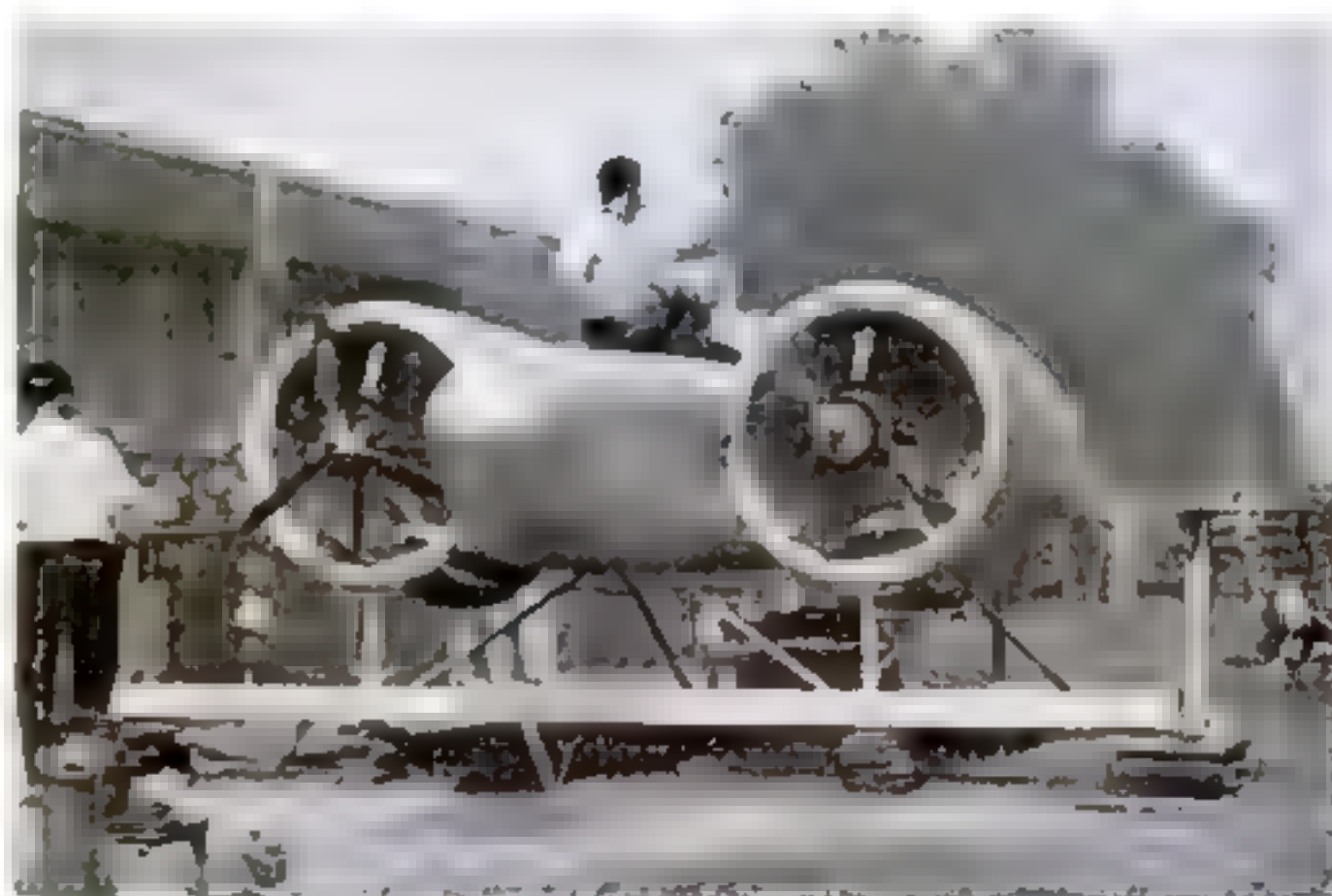


REPORTER'S RAINCOAT HAS WRITING WINDOW

TO FACILITATE taking notes in the rain, a German newspaper reporter has equipped his raincoat with a window of transparent material. By holding his pencil and notebook in front of him, directly under the improvised window, he is able to see what he is writing, and jot down his impressions regardless of the stormy weather. The inventor is seen demonstrating the practical usefulness of his innovation.

MAN-MADE TORNADOES DRIVE ODD PLANE

FOLLOWING successful ground tests of a wooden model, a Stillwater, Okla., inventor has begun construction of a full-sized airplane of radical design that he expects to show unprecedented speed. The craft's twin propellers will blow a tornado of air through a pair of cylindrical ducts, shaped to enhance the propulsive effect obtained, so that its two 100-horsepower motors will do the work of much larger power plants in standard planes.



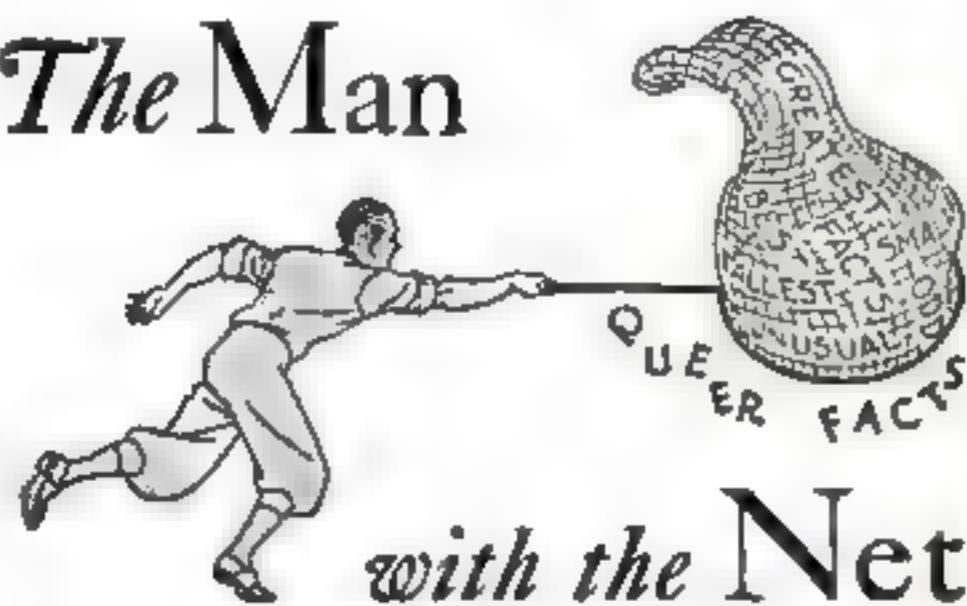
The inventor making a ground test of a full-size model of his unusual plane. Air ducts enhance the power of the craft's two propellers.



BOOKMARK OPENS VOLUME AT PAGE DESIRED

A NEW spring bookmark automatically opens a book to the page where a reader has placed it. Stamped out of tempered brass, the circular device has two wings, bent in opposite directions. When the marker is inserted at a desired page, the weight of the closed volume presses the wings flat. When the book is picked up and held in the hands, however, the spring device gently forces it open again at the place in which it was inserted, giving the reader his mark immediately.

The Man



with the Net

TEETH are the only parts of the body which cannot repair themselves.

HONEYBEES carry a load of nectar weighing half as much as their bodies on an average trip back to the hive.

WALKING on all fours has been found to be an aid in overcoming stuttering.



FLUTES are believed to be the oldest musical instruments.

ROMANS used oil and honey as the equivalents of butter and sugar.

IRELAND is the only country in the world where males have a longer expectancy of life than females.

THE MONGOLIAN ASS can run forty miles an hour for short distances.



WOMEN PASSENGERS flying for the first time relax more quickly than male first-fighters.

TOBACCO PLANTS as tall as sixty feet, have been found growing wild in the lower Andean country of South America.

NEARLY all the glaciers of the world are in retreat.

WHALES, although mammals, have no vocal organs.



PRINTING a hundred \$100 bills costs the Government \$2.45.

THREE QUARTERS of all the food consumed in the United States is perishable.

LICENSES for dog owners, to be revoked on proof of cruelty, are advocated by a Washington woman.

FISH required millions of years to learn to swim. Fossils of the earliest fishes show that they were able only to crawl on the ocean bottom.



NOVEL FIRST-AID BOAT HITS HIGH SPEED

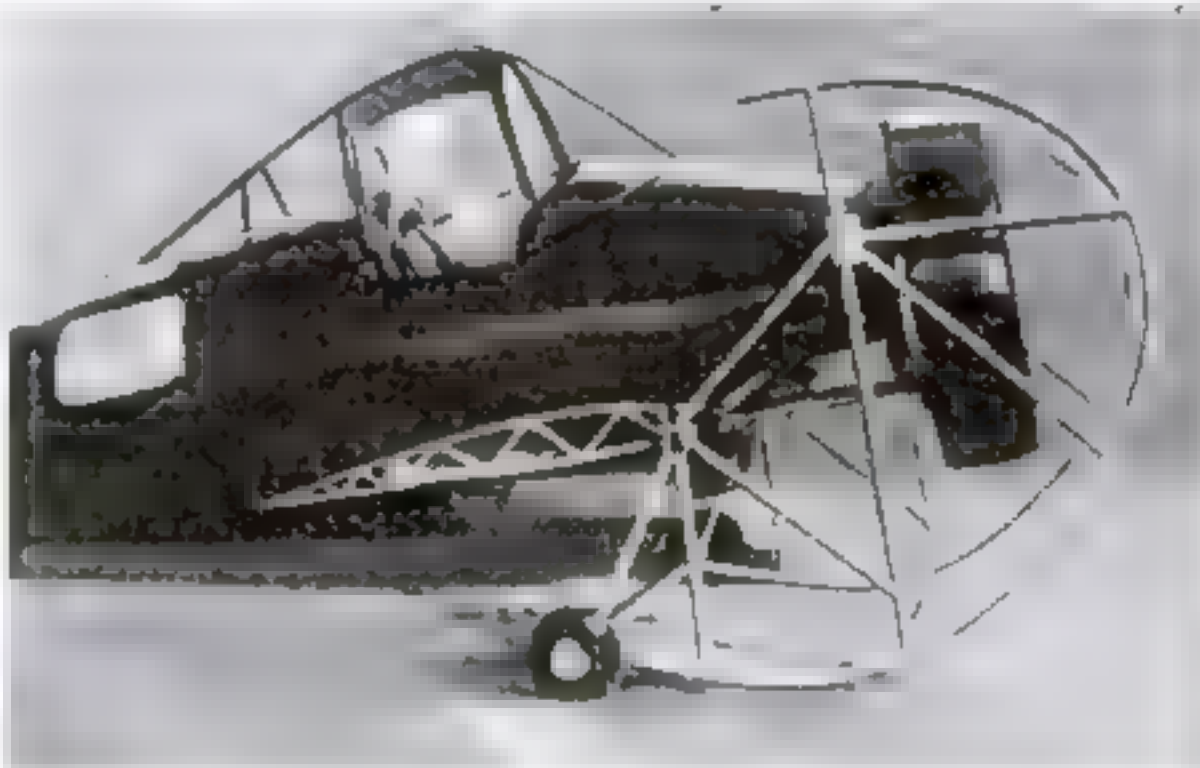


Close-up of streamline marine ambulance and, above, the strange boat under way at high speed

DESIGNED to reach a top speed of more than fifty miles an hour, a unique streamline marine ambulance has just been placed in service by the Portland, Ore., fire department. Stubby wing sections of graduated size, at each side of the hull, act like

airplane wings, enabling the boat to rise from the water and skim the surface. The craft embodies a design that the inventor, Victor W. Strode, demonstrated with an experimental model three years ago (P.S.M., Mar., '33, p. 49).

SAFETY CABIN ENDS NOSE-OVER PERIL



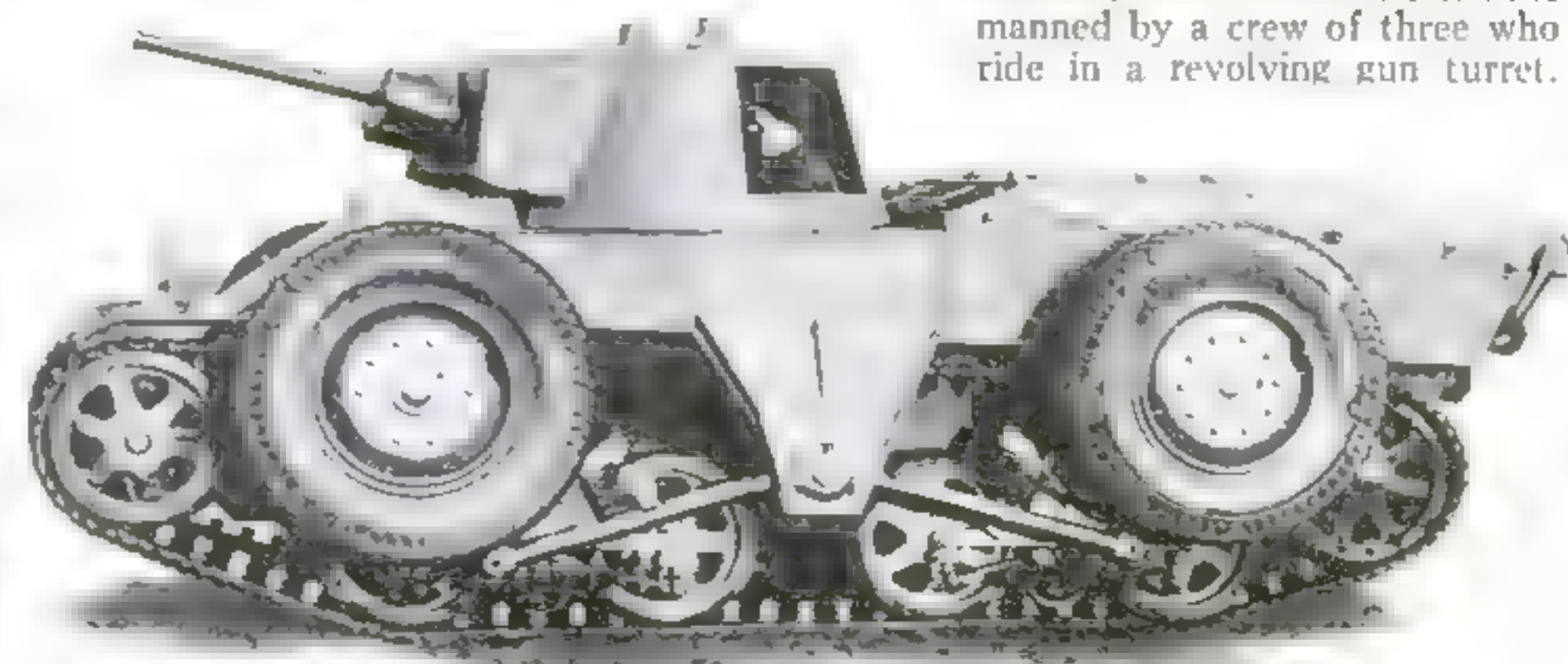
Experimental nose-over cradle attached to plane fuselage

CRACK pilots at Wright Field, Dayton, Ohio, are conducting tests of a new safety cabin for small Army planes, by using a "rocking-chair" cradle which enables them to nose a plane over without injury. Made of linked metal tubing, the odd cradle supplants the plane's regular landing gear and curves upward in front to protect the propeller and engine as the ship flops upside down when making a landing. The safety cabin is protected by a strong beam arched over the top and anchored front and rear.

TANK QUICKLY BECOMES ARMORED CAR

A NEW fighting machine adopted by Swedish military authorities combines the outstanding features of an armored car and a tank. When driven on its four rubber-tired disk wheels, the vehicle races over level ground at forty-seven miles an

hour; when rough, uneven terrain is encountered, a special mechanism raises the wheels clear of the ground and the machine proceeds on a conventional tractor tread at a top speed of twenty-five miles an hour. The change requires only eighteen seconds. The convertible tank is manned by a crew of three who ride in a revolving gun turret.



Swedish war tank on tractor treads. Huge wheels are quickly lowered to make it a fast armored car

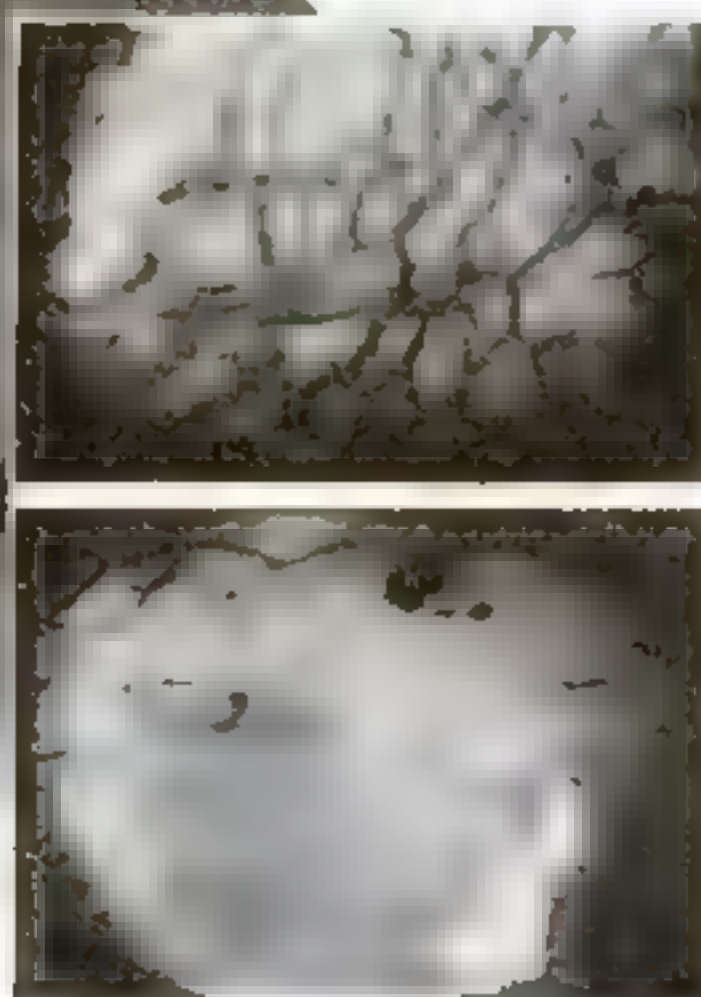
Eye Camera Detects Ills of Blood Vessels



HOW long a patient is likely to live is revealed by an eye camera that has just been placed in regular daily use at a Cleveland, Ohio, clinic for diagnosing ailments of the blood vessels. Like a similar instrument recently advanced as an

Eye camera in use in clinic to determine condition of arteries

Below, patterns of blood vessels in the eye, as seen by the new camera

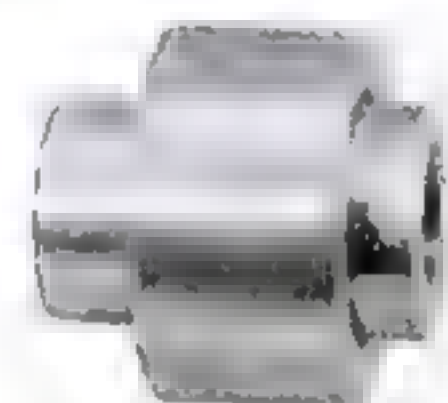


aid in criminal identification (P.S.M. Dec., '35, p. 13), the Cleveland apparatus yields a highly enlarged photograph of the pattern of minute capillaries or threadlike blood passages within the eye. The tell-tale pictures enable medical workers to detect signs of hardening of the arteries, and reveal the first small "explosions" that may be a prelude to fatal changes in the blood vessels. Users of the camera hope that in many cases it will enable treatment to be applied in time to prevent a serious breakdown of the blood vessels, and will thus save many lives.

COUPLING MAKES UP FOR MISALIGNED SHAFTS



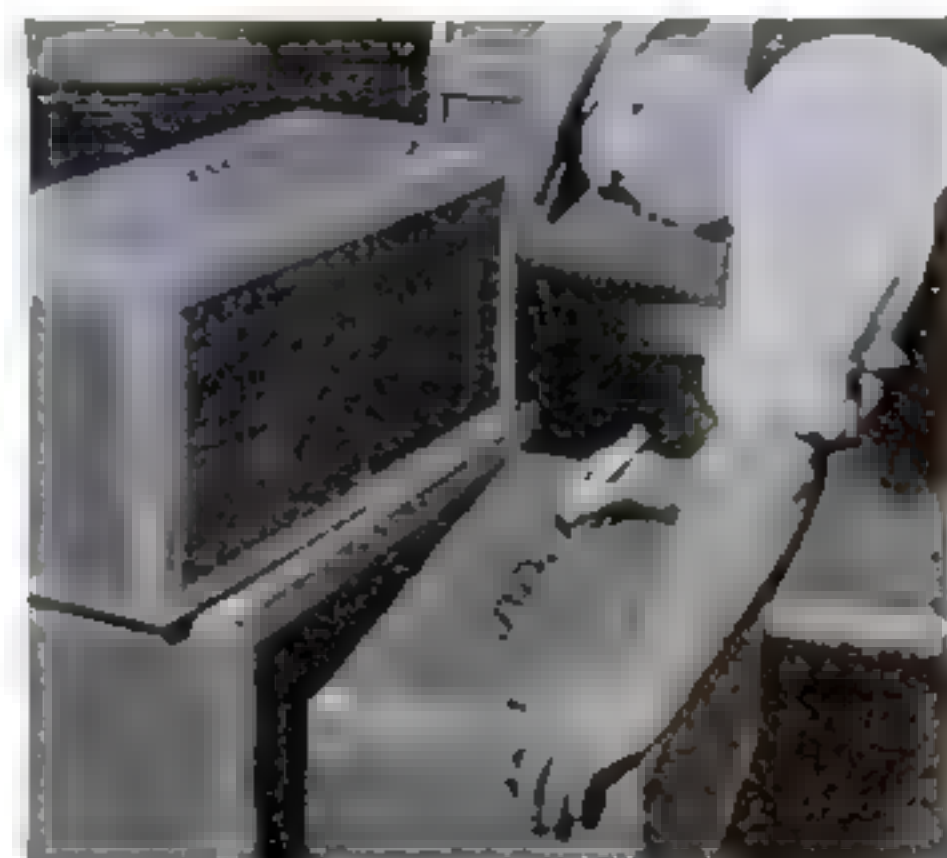
Parts of self-aligning coupling, shown assembled at right



UNAVOIDABLE errors in lining up machine shafts are automatically corrected by a self-aligning coupling recently placed on the market. A notched disk of bone fiber, floating between two pairs of lugs set ninety degrees apart on the driving and driven hubs, compensates for both parallel and angular misalignment in two connecting shafts. The coupling has few parts, is easily assembled, and is said to be unusually quiet in operation.

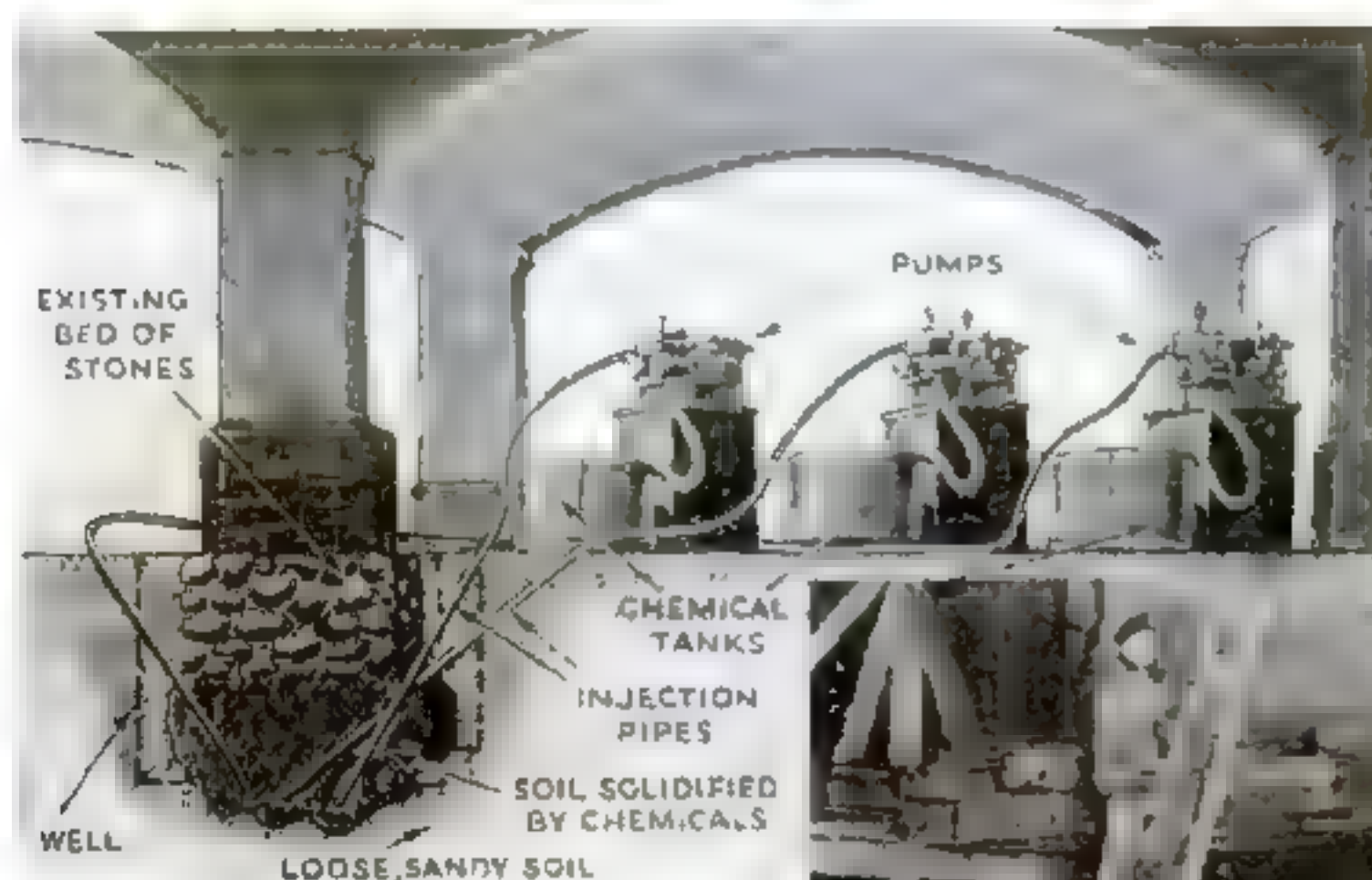
PAINT COMES IN STICK FOR USE LIKE A PENCIL

REAL paint in stick form, which may be carried in the pocket and used like a pencil, has been introduced for marking products and material. The composition is available in a number of colors and is declared applicable to any surface, wet or dry, eliminating the messiness and waste of paint-and-brush methods.



Stick paint being used for marking shipments

CHEMICAL PROCESS HARDENS QUICKSANDS



How an old Danish cathedral was saved by solidifying soil

Below, chemical tanks and pumps set up on subway job to apply soil-hardening process



POROUS, sandy soils are turned into rocklike material by a soil-solidification process recently developed by European chemists. Two chemical solutions, pumped through injection pipes into a sandy base, combine to form a jellylike substance that unites the sand particles into a strong, solid mass. The solidified earth has the consistency of medium-hard sandstone and has withstood pressures up to 1,138 pounds to the square inch. The sand-hardening process has proved successful in strengthening the tunnel walls of the London subway, in hardening sand under building foundations, and in plugging underwater leaks in dams and in beds of spring-fed streams. An interesting application was in bolstering the

sagging foundations of a historic cathedral in Denmark. American highway officials believe the method may aid in hardening sandy country roads.

Modern Movie Magic

Brings Realistic
Scenes and Sounds
To Your Theater



A studio worker clapping boards together in front of the camera to mark the beginning of a "take." This action, registered in both scene and sound track, aids cutters in matching sound with movement, as at left

By ANDREW R. BOONE

TWO years ago, the hundreds of motion pictures flowing out of Hollywood were hit-or-miss film plays. Often, enough negative was exposed on a single production to provide 100 or more full-length features.

Today, many pictures are being preëdited according to time-tested engineering principles like those used in the construction of buildings, bridges, and dams.

M. J. Abbott, former industrial engineer, now script analyst on the R.K.O. lot in Hollywood, has brought this latest application of science to the movies. He prepares a time-schedule graph of each photoplay long before cameras begin to grind out footage. He informs the director how long each scene shall run, how many minutes each of action, dialogue, songs, and dances he may film.

Abbott has created "standards of value" for all sorts of scenes. These are based on analysis of past box-office successes. His time graphs reveal at a glance exactly where, to the foot, each type of "picture value"—action, music, talking—begins and ends. In a few seconds, the director learns whether his picture will be properly balanced. Thereafter, he follows the required tempo, whether the picture be melodrama, comedy, or western.

Actors are timed by stop watch. Each scene is allotted its time to a second. Here's how one recent picture, "Follow the Fleet," breaks down: action, forty-four and two thirds minutes; dialogue, twenty-one and two thirds minutes; inserts, eight ninths of a minute; titles, two minutes; singing, eleven and one third minutes; dancing, sixteen and one third minutes. Total time, ninety-six and eight ninths minutes.

By controlling each day the length of each scene, Abbott reduces costs for his studio, saves shooting time,



To give special tone qualities to dialogue or sound effects, they are amplified by these three loudspeaker horns in an echo chamber and picked up again by a recording microphone

Speed is the essence of picture making, for each major studio completes fifty or more features every year. What goes on behind the scenes?

Seldom do more than two weeks elapse between the morning a production manager receives a copy of the script, which is a complete story including all action and perhaps 600' speeches, and the time when cameras begin to turn. But what days and nights make up those two weeks!

pens: In most studios the unit manager, who works under the studio production manager and meanwhile has two other pictures shooting or in preparation, breaks down the script into scenes, determines from the scenes how many and what sets may be required. Knowing the sets, he prepares a work schedule. He may find that the picture can be filmed in twenty-four working days, or it may go to sixty, depending largely upon the number, size, and location of the sets. One recent picture required only four sets, all within the sound-deadened walls of two sound stages; another, sixty sets, scattered from odd corners of the lot to distant mountain and desert locations.

Having made the schedule, he prepares a budget, for not one penny can be spent until studio heads approve expenditures, including hundreds of items, from typing to talent. Each of many department heads submits a cost sheet for the work he will have to do. The art director estimates the cost of drafting plans for sets, and finally constructing and dressing them. Other estimates pour in, covering properties, which include all the incidentals, from furniture to safety pins; wardrobe; location; make-up; electrical equipment; cutting; projection; photographic effects (trick shots); stock shots (from former pictures and the newsreels); still photographs; transportation; rentals, meals on location; special effects (rain, fog, snow) re-recording; casting; and, finally, sound.

Like a well-oiled machine, the many workers speed their

plans and in an incredibly short time the unit manager announces to the director that all is ready; tomorrow he may call his company. These wizards of movie production have been known to break down a script into scenes, plan the sets, provide costumes and properties, and be ready for the cameras in forty-eight hours—on a picture costing a half million dollars!

When the first set is ready, the company moves in and action starts. Rehearsals are largely a thing of the past. Now, the cameraman and sound recorders demand that they catch the actors in their first natural "reactions" to their lines.

As each scene progresses, a large number of people work unceasingly to keep the wheels of production turning smoothly. One unit manager told me at least thirteen people are required behind the scenes for every principal in the cast. Since the average picture requires the services of ten principal players, fully 130 technical people are engaged in manning the many lights, shifting properties, timing the start and stop of cameras, recording sound, cutting the picture, creating special effects, re-recording a variety of sounds on a final master sound track, matching sound and picture, developing each day's negative, and making positive prints.

WERE you able to stand behind the camera on a modern sound stage and follow production of a feature-length picture from the simple dialogue of, say, a drawing-room scene, through the multitudinous steps to the final picture, you would find an army of people performing amazing feats of magic.

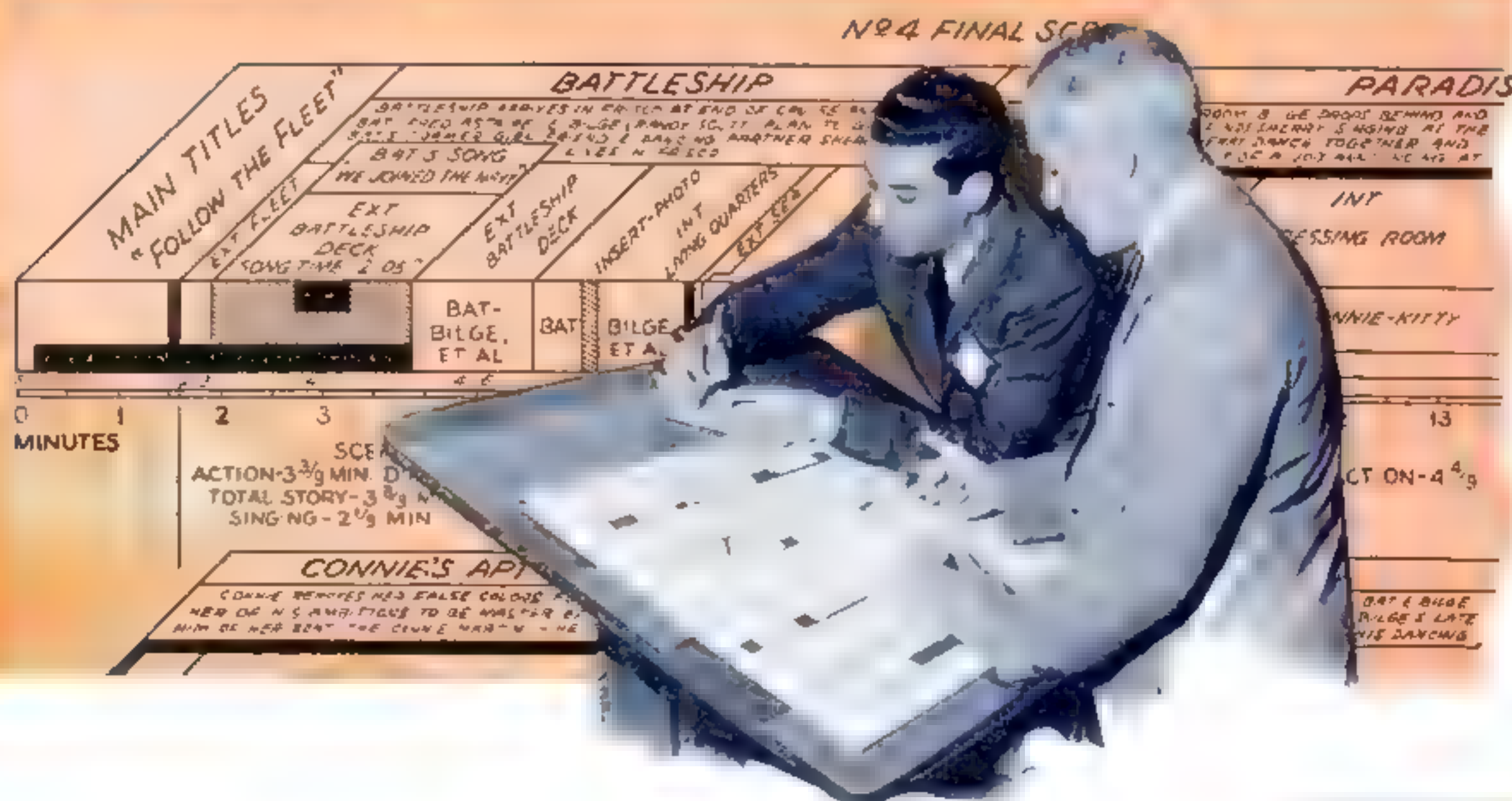
Suppose we stand a moment outside the camera line on a Hollywood sound stage. "The Prisoner of Shark Island," is shooting. A whistle blows, calling for silence. The camera whirs. A solemn youth steps before the camera and on signal indicating the camera has attained "speed"—movie film runs through the camera at the rate of ninety feet a minute—claps two hinged boards together. The camera films the action; the recording mechanism the sound. Later, by matching the two, the film and the sound track can be synchronized.

Now the director puts the actors through their paces. Once, twice, ten times he calls for long shots, medium shots, medium-

Below, Director Mark Sandrich, at left, and M. K. Abbott timing dialogue to see that it agrees with the final time schedule, a section of which is reproduced in the background



Film-developing tanks with framework raised to show mile-long blank film negative threaded over spools, ready to draw exposed negative through the twelve chemical baths in the tanks



close shots and close-ups. At the close of the day's work, the camera on stage and the sound-recording unit offstage—perhaps in a portable sound truck outside—have exposed 3,000 feet of film each. With the close of the day's shooting, a dozen departments swing into action.

First, the laboratory develops the film at night, and sends it the following morning to a projection room where selected scenes are viewed by studio executives. These are known as "rushes" or "dailies." Better scenes are chosen and matched with the dialogue possessing greatest clarity.

Action may be better in one take, dialogue better in another. Any two can easily be combined. After officials view these "rushes," the cutter starts assembling the scenes. At first, he leaves each scene long in order that the first assembly of the complete photoplay will total 8,500 feet, permitting judicious whittling to the standard release length which usually runs to approximately 7,500 feet.

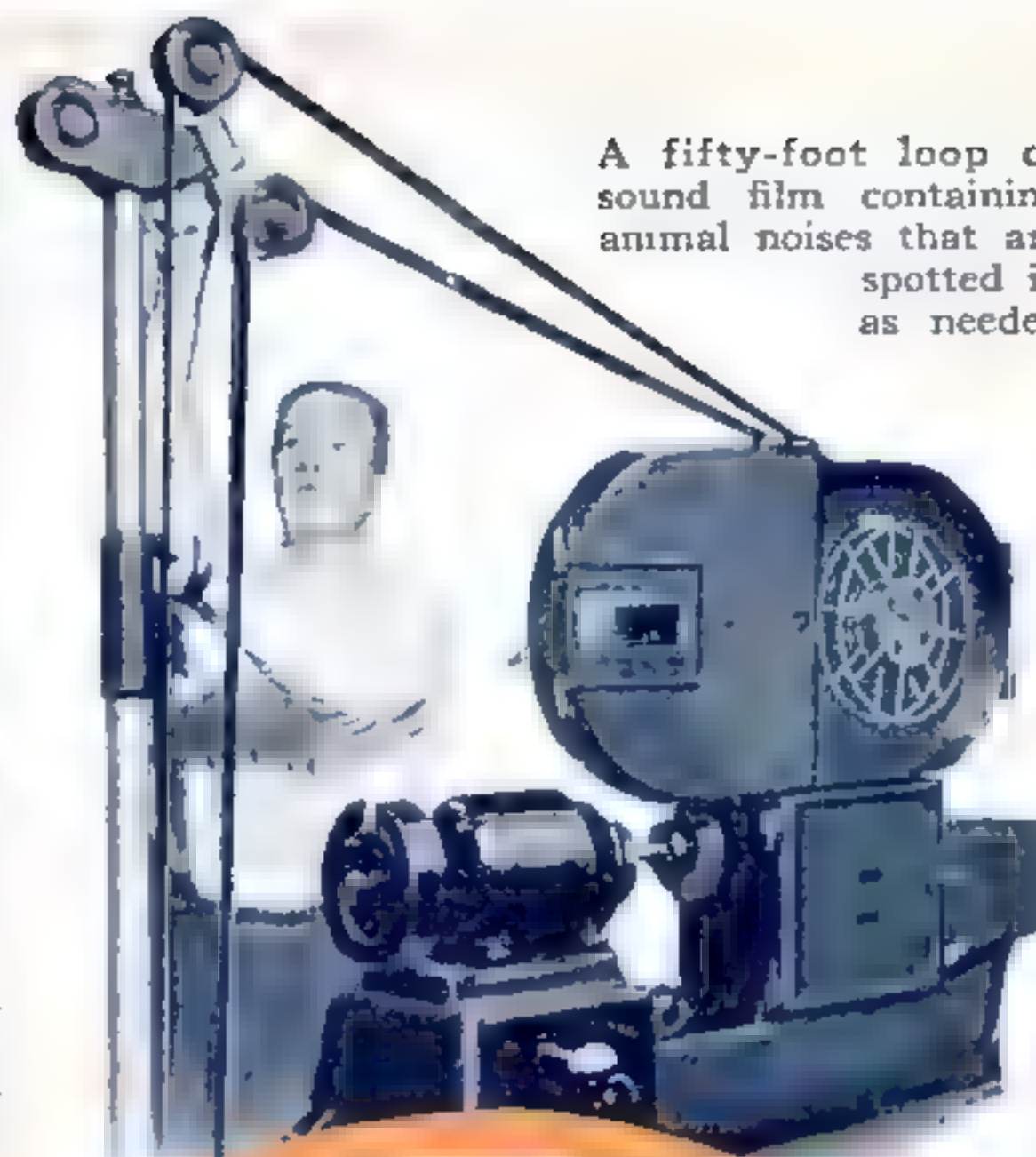
The cutter overlaps the picture and sound film in a synchronizing machine, matching the point where the hinged boards clapped together. A series of key numbers, spaced exactly a foot apart, run down the sides of the films. Thereafter, no matter how long the scene, he can match picture with sound track by comparing these numbers.

Although the last scene may be filmed first and the first somewhere about the middle of production, the cutter need only refer to the script as a guide in assembling the many scenes. He usually opens the picture with a long shot, which reveals where the people are and what they are doing. From there he cuts to a close-up, then proceeds to build the picture according to the story as it has been written in the script.

Sound effects and music come into being when the producer approves the first cut of the completed picture. He spots music and effects where he thinks they will be effective or necessary to the action. During this time, cutters will be shortening and rearranging scenes. Usually, a picture is cut five times before it finally reaches the theater. Whole sequences may be dropped, lines may be cut out, people moved about more quickly by opening a scene later; all this for the sake of one essential—action!

When the musical

A fifty-foot loop of sound film containing animal noises that are spotted in as needed



At right, a technician listens in as a sound camera re-records sounds from various sources on the final master sound track. Below, an air view of a modern movie lot. Note the outdoor sets





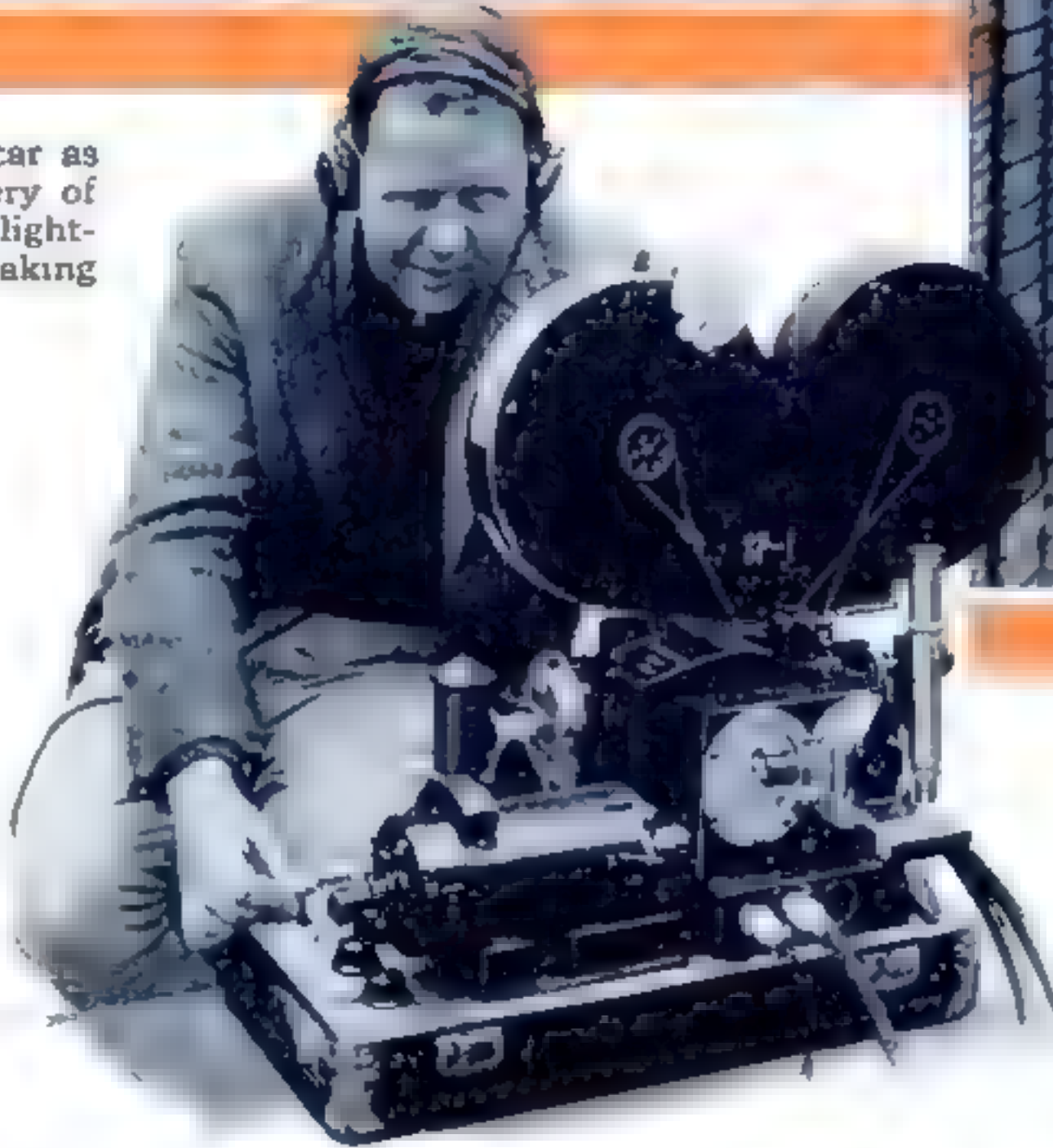
The interior of a New York subway car as re-created on a movie lot. The battery of lights above the director shows why lighting is an expensive item in movie making

director receives his order to provide a number, he is told exactly how many feet of film are available. Take a cafe scene, for instance. It is to open with incidental or background music as the hero enters the door, and continue until he departs 630 feet later on. That's exactly seven minutes according to the time graph. In rehearsal, the musical director times the orchestra with a stop watch, for they must finish the number on the picture frame showing the door as it swings closed; within two thirds of a second of the prescribed time, to be quite accurate.

Day after day, the shooting continues, and when at last the director announces, "she's in the can," meaning literally that the picture is ready to be rolled and stored in a tin can, the re-recorders and sound-effects men begin their tasks of mixing all sorts of sounds with the dialogue.

Two men, sitting at a mixing panel where they can control electrically the volume of the sounds coming from several films at the same time, may "dub in" as many as eight sound effects in a single scene. In a recent historical picture, for instance, one sequence of shots showed actors talking, a bugler sounding a call to advance, guns firing, horses running, an elephant trumpeting, chains on elephants' feet rattling, a man yelling, and horses screaming. When these men received the picture, the only sounds issuing from the loudspeaker were the voices of the actors and the bugle call.

Sitting at a mixing panel in a small projection room—a theater in miniature—Roger Heman, re-recording engineer on the Twentieth Century-Fox lot showed me how the sounds were mixed and re-recorded. Through eight machines in a near-by room, all synchronized electrically,



Charles Laughton, motion-picture star, listening to dialogue registered by a portable sound recorder in operation outside a Hollywood sound stage

negatives of varying lengths were threaded. Each was ready to pour forth its individual sound at the turn of a knob.

On a small screen, before two recording experts, the scene unfolded. Eight times the picture was viewed, and on each run the two men rehearsed "bringing in" the sound. At last, knowing they could turn on the various sounds at the proper volumes to match the action, they made the "take," while a second assistant, listening to the assortment of noises through earphones, attended the sound mechanism which recorded on a single strip of film, through the medium of a light valve, the nine sounds. These included the original dialogue. This new film became the master sound track, matching frame-by-frame the action recorded several days earlier.

Sounds "dubbed in" on pictures seldom are produced by artificial means. Stored in the several vaults on the Fox lot, for instance, are hundreds of flat cans containing, on celluloid, 2,500,000 feet of all con-

Below, a scene in the concrete vault in which one movie company keeps 2,500,000 feet of film, recording various sounds for "dubbing in" with the dialogue "takes"



ceivable sounds including the sizzling of frying bacon, the songs of mocking birds, the squeak and pop of bottle corks, coins dropping into pay-telephone slots, cowbells, and every known cathedral chime in the world.

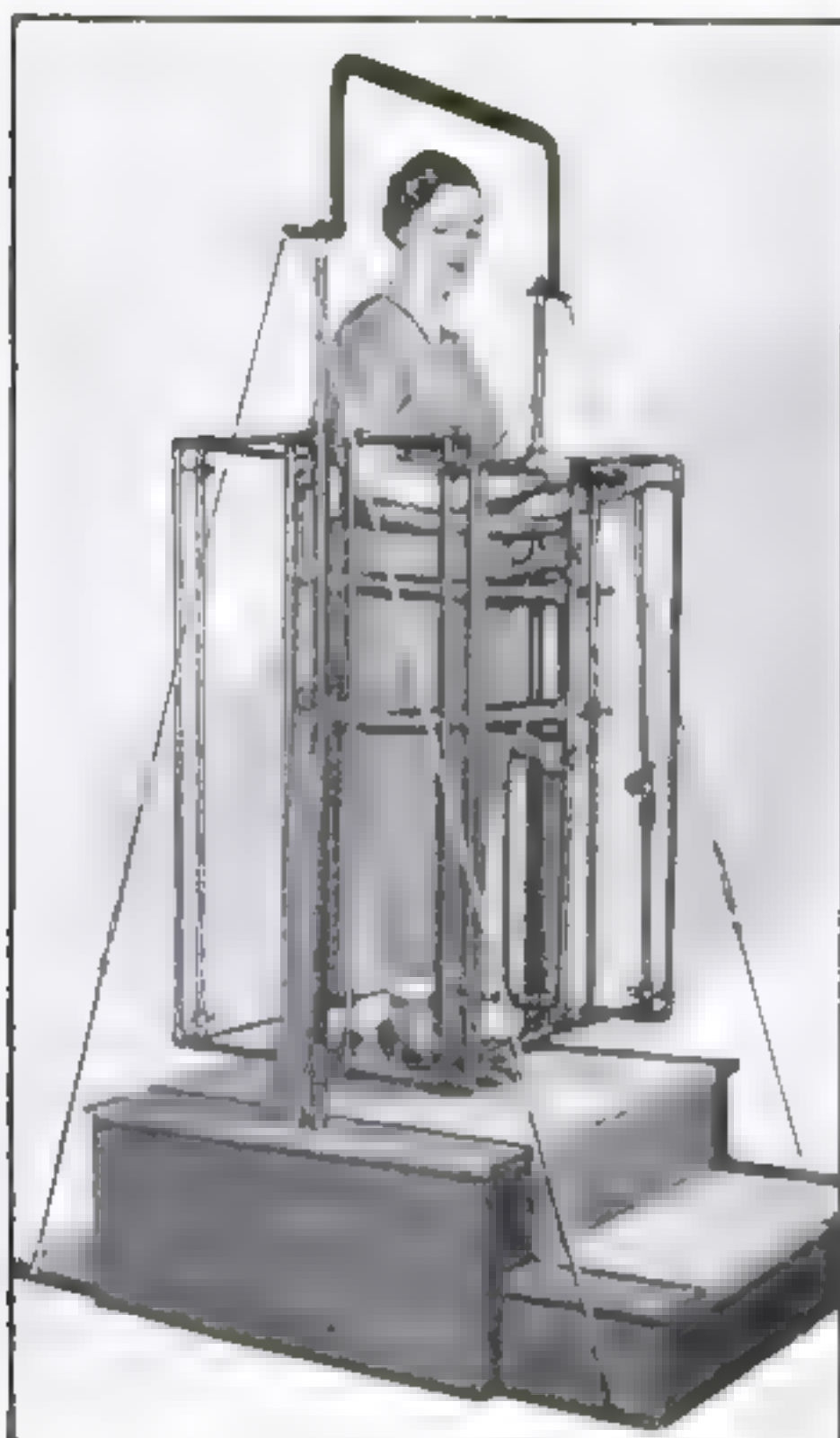
Sounds with individual characteristics, such as a man shouting, must be matched very carefully with the picture. Others, including tramping feet, wind, rain, and horses galloping, are threaded into the machine as an

endless loop and run continuously. Here the recorder need only step up the volume control and use as many feet as required. Not infrequently, 500 feet of such an effect which you hear in the theater roll out of a loop only fifty feet long. In fact, loops as short as eight feet have produced sound for a 400-foot scene.

What was the source of the sounds I heard? Conversation, of course, was recorded when the picture was filmed, as were the bugle calls. Gunfire was recorded separately, by means of a microphone cleverly hidden from the cameras, when the soldiers "went over the top"; the horses' screams and the elephants' trumpeting were similarly obtained separately when the horses and elephants stampeded; chains on the elephants' feet were in reality artillery caissons clacking over cobblestone streets in France, caught by a newsreel recorder two years earlier and available in the sound library; the man yelling was drawn from *(Continued on page 124)*

ODD MASSAGING MACHINE USES JIGGLING FRAME

INTENDED to remove surplus weight and to stimulate circulation, a strange motor-driven massaging machine has been devised by a Tulsa, Okla., woman. The subject stands erect within a cage-like frame of iron, and from six to eight rollers resembling large coil springs are fastened about her. When an operator throws a switch, an electric motor imparts a reciprocating motion to the frame, which oscillates vertically, and rollers apply a massage that varies with their adjustment.



Spring rollers attached to the moving frame of this reducing device massage the user's body

MAGAZINE TACK HAMMER

ONLY one hand is needed to hold and wield a tack hammer of new design. A refillable magazine concealed in the head contains a clip of fifty staple tacks, and pressing a trigger on the handle of the tool feeds a new tack into position. The one-hand feature aids tacking in awkward positions.

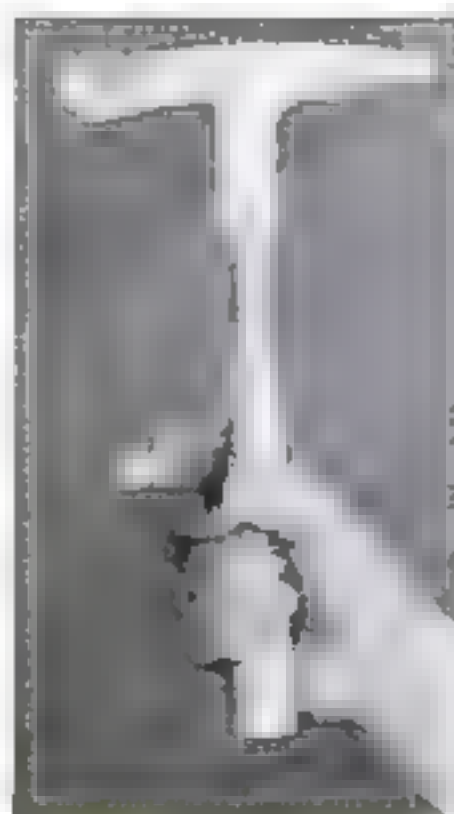
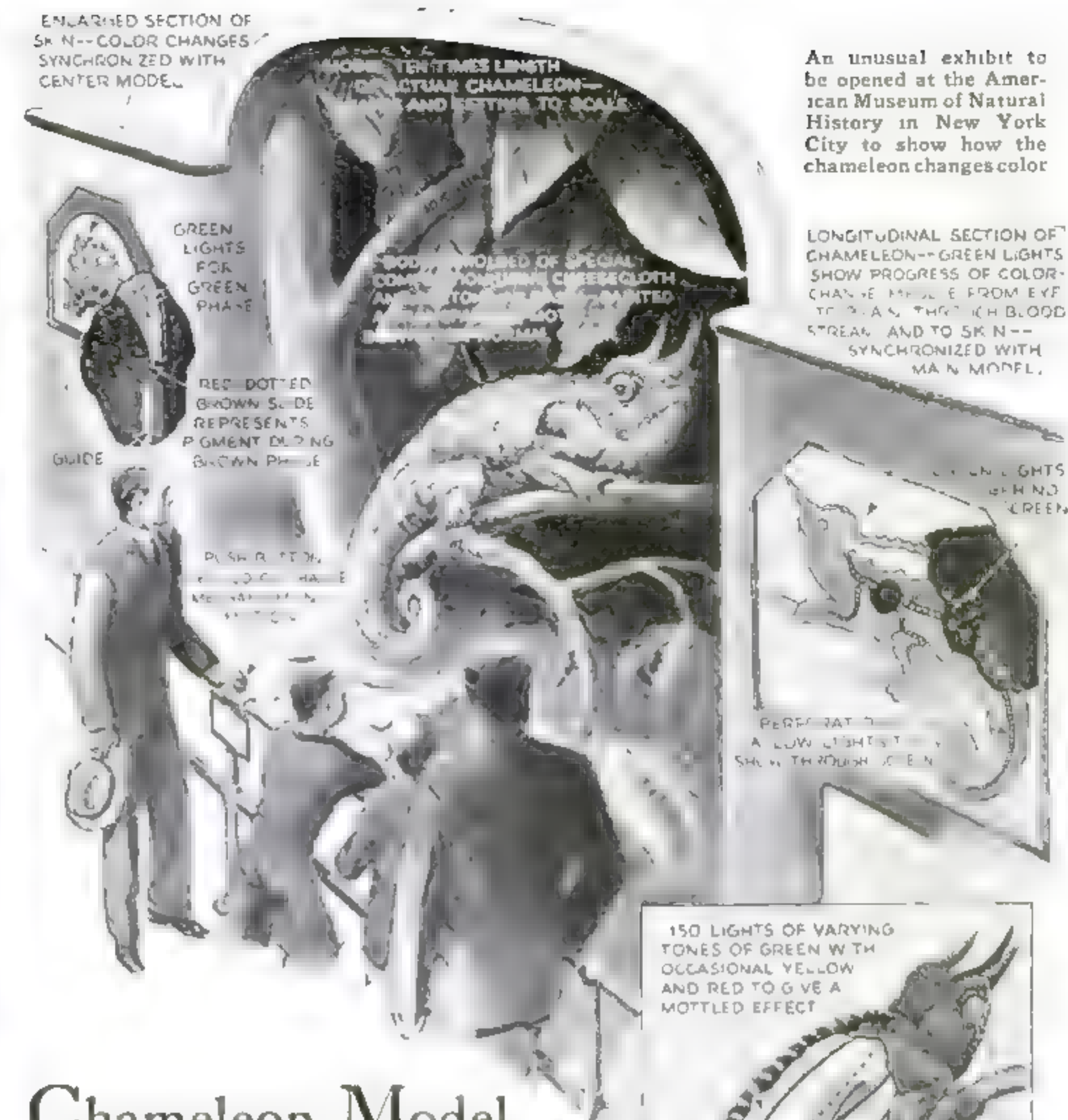


EXHIBIT EARLY STREAMLINE LOCOMOTIVE

RESEMBLING a monument shaft on wheels, an "ancestor" of the modern streamline locomotive is preserved at the Smithsonian Institution in Washington, D. C. The electric-powered engine is said to have attained a speed of 120 miles an hour in its first trial run, in 1889, but met with an accident that ended an ambitious project to use it in a twenty-four hour transcontinental freight service.



Chameleon Model Shows Color Change

HOW a chameleon changes its color to match its surroundings is soon to be demonstrated to the public by a seven-foot model under construction for the American Museum of Natural History. The mammoth representation of an African species, that attains a length of seven to eight inches in real life, will turn alternately brown and green as it looks at foliage first of one hue and then of the other.

An enlarged section of the skin of the lizard, and printed legends, explain the actual mechanism of the mysterious change. Starting from the outside, the skin of the chameleon consists of a translucent layer; a layer containing yellow pigment; a layer containing a substance that reflects blue light; and a deep-seated layer consisting of cells containing black pigment. By expanding or contracting, the latter control the amount of light reflected from the blue layer and so effect the color change. When they are expanded, little blue light is reflected, and the combination of the black and yellow layers gives the chameleon a brown hue. When the black

A slowly revolving six-bar commutator controls the 150 lights inside model

cells shrink, considerable blue light is reflected, and as it emerges through the yellow layer the combined color effect is green.

In the monster model, the change is shown by alternately dimming and brightening a series of green lamps beneath a translucent brown skin, the change being made gradually by a slowly revolving commutator. Another panel shows how the color reaction spreads through the body.

Experimental streamline locomotive which was tried out in 1889



Marvels of Plant Breeding

Experimenters working on scientific seed farms create new varieties with greater eye appeal and food value

By ROBERT E. MARTIN



It required decades of careful breeding to produce this rounded head of Hollander cabbage

IN CLEVELAND, Paducah, or San Diego—take your choice of communities—a housewife declines to purchase a head of lettuce at the corner grocery because the green leaves are wilted and spotted with brown.

Kneeling before a thriving lettuce plant in a fertile California seed field, an expert in the development of vegetable seed carefully forces the sharp tips of a pair of forceps between the sepals of a flower, squeezes the bud open and touches the stigmas with the pollen-covered surface of an anther recently cut from the same plant. This done, he ties a bag over the treated bud to protect it from the weather, fungi, and insects.

Seemingly unrelated, these two very real incidents are causing to be created year by year thousands of superior strains of vegetables to be consumed by 127,000,000 Americans and uncounted millions in countless other countries of the world.

"Selfing" is the term employed by seedsmen to describe how they are forcing choice plants to reproduce themselves in vast numbers that the quality of the nation's vegetable supply may be bettered. This is accomplished by hand pollination. Again, bees and flies make their homes within the narrow confines of canvas cages used to isolate groups of selected parent plants and carry pollen from one open flower to another. Ladybugs mingle with the other insects and kill the aphids, or plant lice, which otherwise would destroy many of the new vegetables in the making.

In the bags and cages of western and midwestern seed farms vegetable plants by the hundreds of thousands are being "selfed" and crossed, thus not only improving the quality of every variety now on the market, but also combining the best features of two or more in a single strain.

From these open-air laboratories, with occasional contributions from abroad, come all the vegetable aristocrats of the dinner table. Red cabbage, yellow cauliflower, corn with staggered rows of grains—



Plants covered with muslin bags to control pollination. At left, a cage being built around a young cauliflower to be pollinated by hand



Equipment for collecting tomato seed. Juice and seed, separated from the pulp by a thrasher, are fermented in barrels and the seed are then washed clean in a flume

Produce Better Vegetables

A specially designed ring roller in use to roll out lettuce seed on canvas sheets where they will dry in the sunshine



all have come or are now on the way because the public demands something new and an ingenious seed grower finds a way to produce it.

Only one really new vegetable—green broccoli—has been given to the nation on a large scale during the last decade. At one time, a few Italian market gardeners in the vicinity of New York grew broccoli for their fellow countrymen. Then Americans acquired the taste, and seedsmen began to try for improved strains.

The procedure is typical of their efforts to give the housewife not only vegetables of high food value, but also vegetables which please her eye when she walks into the store seeking the raw materials for her evening meal.

In a California field were planted seeds from European producers. They and their progeny were tested for five years, and then seedsmen knew exactly what Europe had to offer. Most of the varieties tested proved worthless under conditions existing in the United States, but a few strains proved well adapted to our climate.

THE same study convinced seedsmen that European sources of supply for seeds were uncertain, so they started the long process of improving and increasing the stock. Especially desirable plants were located among their own crops and carefully transplanted to the breeding grounds. As these plants shot up their seed stalks, and before any blossoms appeared, each was covered with a muslin cage. Then these wizards of the vegetable fields performed another of their feats of magic.

Formerly these plants were considered "self-sterile"; that is, few seed could be produced from a broccoli pollinated by its own pollen. The seedsmen met this challenge by saving the few seed yielded by each of the selected specimens and planting them the next spring, again selecting from these and caging several together. Then they carefully brushed pollen from one plant to another in order to secure a little more seed. The resulting seed again were grown, further selections made, and again the new seed planted. At last, an

isolated plot was grown to seed, and after these were tested for two additional years a new strain of broccoli was offered to the public.

Although they seldom find anything entirely new, the seed growers comb the world for ideas. They are constantly crossing standard varieties with half-wild plants from India, South Africa—everywhere, in fact—seeking to acquire new color, disease resistance, earlier maturity.

On the 100-acre trial grounds of the Ferry-Morse Seed Company, at Salinas, Calif., for instance, I recently saw a dozen fine, large heads of cauliflower. Six were purple, six yellow. They were growing from seed received recently from Europe. In another three or four years one of these colors may become so popular you'll be serving gay-tinted cauliflower to your dinner guests.

Not infrequently, a little-known seedsman brings to some prosaic vegetable a much desired quality, such as resistance to a particular disease, from a useless product of a foreign country. For years, growers periodically saw their spinach crops ravaged by mosaic disease. Now, that disease has been overcome by crossing the short-leaved spinach every American knows with a narrow-pointed spinach from Manchuria. In ten generations, a single Manchurian plant gave its mosaic resistance to our commercial spinach, at the same time imparting none of its undesirable qualities.

Because housewives and canners demand "good-looking" vegetables, seed growers effect many changes. Chances are, the beet you eat tonight bears little resemblance to its ancestor of a few years back.

Here—in brief—is the beet's story, an evolution typical of many vegetables.



Parsnips from a scientifically grown crop. Samples are being selected for a check to determine if the strain is "steady" Top, the tape measure shows a celery plant to be twenty-seven inches long—the result of generations of control breeding

Twenty years ago, nine tenths of all beet seed planted in the United States were imported from Europe, but the quality of beets grown from those seed never appealed to canners and market growers. They showed white rings which, while not lacking in food value, detracted from their appearance when diced or sliced.

Wizards of the seed grounds swung into action. Likely specimens were planted, seed of better plants were saved and planted—and finally, through selection, was created an all-red beet. Not only did this result in American growers capturing the home market, but also a large part of Europe's population now is eating beets grown from American seed.

Year after (Continued on page 128)

ARTIFICIAL WOOD

Offers New Effects in Home Decoration



A slab of the new material, cut to size, being applied to a wall. In a new house, such pieces can be nailed directly to the wall studs. On old walls, they are cemented and nailed to the plaster.



Walls and beams in this room are imitation wood; the floor is made of artificial stone.

ARTIFICIAL wood, made to resemble costly panels of oak, walnut, or pine, is bringing new richness and beauty to the moderate-priced homes of America. Built into new houses under construction, or applied by home owners to existing walls, a new, inexpensive plastic-veneer paneling represents a further achievement of science in imitating a valued natural product.

Made in a wide variety of styles, the new material simulates almost every known wood finish, either natural or polished, from the gnarled texture of hand-hewn oak to the gleaming surface of polished walnut. Cut and handled like ordinary lumber, it can be applied easily by anyone who is handy with hammer, saw, and sandpaper. By the addition of ornamental moldings, friezes, and other trim in natural wood, rooms may be paneled in authentic period styles, such as Georgian, Jacobean, or Victorian.

The artificial wood consists of a mastic mixture of oil, cement, pigment, and various chemicals, which is spread in a thin layer over an ordinary wall-board base. At the maker's factory in New York City, the various ingredients are mixed and emulsified in fifty-gallon vats by means of a secret formula. When the different elements have been thoroughly blended, the mixture develops the consistency of a liquid paste and the color

of natural, unfinished wood. It is then removed from the vats, poured into special containers, sealed against air and moisture, and aged in curing rooms which are kept at an even temperature.

When the paste is sufficiently cured, it is smeared over sections of wall board and smoothed with a trowel to a layer about one sixteenth of an inch thick. The slabs of surfaced wall board are then set aside to dry.

When partially dry, but still somewhat soft, the veneer surface is ready to be transformed from a dull, flat area of colored paste into the rich mellow tone and graining of a costly wood surface. Skilled artisans score, scratch, scrape, and rub up the paste with special tools to secure the exact grain, texture, and contour of finished wood. Knot holes, grain whorls, eddies, and all the peculiar identifying marks of natural wood are faithfully matched. The veneer is then stained to the true color of the particular wood being copied, and allowed to harden. The slabs are then ready for use.

Installation of this artificial paneling is a simple matter, for the job is practically



A factory workman spreading a layer of mastic material on plain wall board. Right, staining the veneered board a wood finish.

Sawed and handled like natural lumber, the artificial wood can be applied without special equipment by any home craftsman.

"tailor-made." Sold to order, the imitation wood panels can be obtained cut to convenient sizes. The home owner or builder simply selects an appropriate style—oak, knotty pine, or walnut—and submits a dimensioned plan of the room to be decorated with his order. When the material is delivered, it is pre-cut to the most convenient lengths and widths to fit the specifications of the room. Additional cutting and fitting is kept to a minimum and waste is practically eliminated.

To apply the panels to an existing wall, the builder smooths the edges with sandpaper, smears a thin layer of a special cement over the wall surface and, starting at the floor, places the boards against the wall and nails them to the plaster, one by one. In a new house in the process of construction, the veneered boards can be applied directly to the wall studding, thus eliminating the necessity of a plaster wall. Unless the wall area is broken up by an unusually large number of doors and windows, the builder will have to measure and cut only a few small sections to fill in the gaps that remain after the larger slabs are in place.

Real wood is used for cornice, chair rail, molding, and all other trim and is nailed directly to the veneer. The counter-sunk nail holes are then filled with putty and, together with the trim, are stained to match the paneling. Finally, the entire wall is waxed and polished.

Taking into consideration the work necessary to prepare and apply real wood paneling, the cost of a complete job with this artificial board is from one third to one half less. According to the manufacturer, rooms paneled with these mastic-veneer slabs cost on the average little more than the price of a first-class plaster-and-paint finish.

Because of its cement content and its careful method of application, the mastic-veneer surface is said to unite

with and actually become a part of the wall-board base. It will not warp, buckle, or chip, even when exposed to severe conditions. It is moisture-proof and unaffected by sudden changes in temperature. A waxed cloth rubbed over the finish keeps the surface in the best of condition.

The veneer can be applied to any type of wall board. When fireproofed wall board is used, the covered wall is completely fireproof, since the top layer of mastic veneer itself will not burn. This is an important point, since many cities have ordinances prohibiting the use of inflammable paneling in certain types of buildings.

Flooring also can be decorated with the mastic material. In this case, a hard, non-flexible building board generally is used as a base, although it is possible to apply the veneer over linoleum, which can then be laid out in strips and cemented or nailed down. The result is a floor surface of resistant, long-wearing qualities.

Not only walls and floors, but even furniture will be finished in the new material, if experiments now being carried out prove successful. The plan is to apply the paste as an outside coating over a foundation frame of strong but inexpensive wood. In this way, chairs, tables, desks, and cabinets could be *(Continued on page 125)*

Industry Imitates Costly Paneling in a Convenient Material That Can Be Cut And Worked as Easily as Ordinary Natural Lumber

By
HENRY ALBERT PHILLIPS



End of a veneered board planed away to show mastic layer one sixteenth of an inch thick

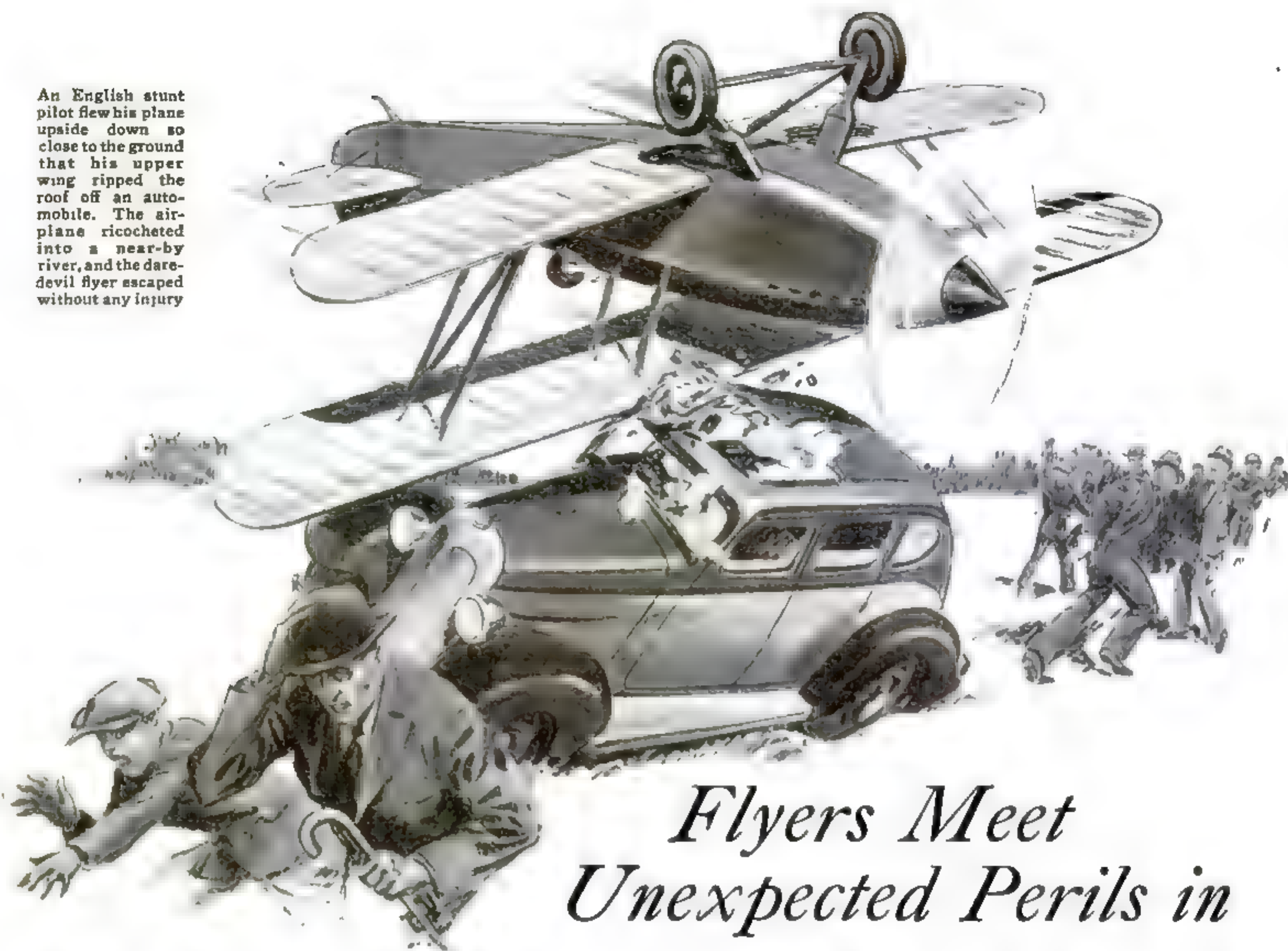


In oval, a molding strip of natural wood is being nailed to a panel of the artificial product. The beautiful "woodwork" in photos below and at right is of the new material



A blowtorch flame playing on a panel of "knotty pine." The top layer will not burn; when the base is of fireproof board, the slab resists flames

An English stunt pilot flew his plane upside down so close to the ground that his upper wing ripped the roof off an automobile. The airplane ricocheted into a near-by river, and the daredevil flyer escaped without any injury.



Flyers Meet Unexpected Perils in Queer Airplane Accidents

FLASH: Airplane lands on box car; pilot not seriously injured. Tear gas drives pilot from plane in midair. Inquisitive buzzard flies out of his path into plane; buzzard dies, plane crashes. Electrical storm plays ring of fire around propellers; no damage. Airplane engaged in artificial rain making catches fire.

Week by week is recorded the history of sensational escapes from death, the tragedy of air crashes under strange circumstances, queer occurrences that seem well-nigh unbelievable. Yet their strange stories are being constantly written on the blotters of police departments and in the record books of airports, Coast Guard, Army, and Navy.

Here, there, everywhere, people flying in airplanes find themselves involved now in amusing, again in tragic mishaps. Let's skim around the world on the trail of the odd and unusual.

Graz, Austria. An instructor and student crashed, both falling from their cockpits into a lake. The pilot towed the student ashore, then dashed to the near-by railroad to flag a train approaching high-tension wires which his machine had knocked down across the tracks.

Moulins, France. At one o'clock in the morning, as a mail-and-passenger transport

roared through a black sky between Paris and Marseilles, the radio operator saw flames licking at the engines. He jumped, pulled the rip cord, walked ten miles through the night to a telephone, and reported the crash and the pilot's death to authorities. Meanwhile, the pilot fought and conquered the flames while continuing his course, and landed at his next regular stop on schedule. There he waited until the radio operator caught up with him on a train.

Liverpool, England. Pierre Vanlaer took

his small sport plane up for a short hop. When he touched earth again he was 3,578 miles away from home. Pierre sought to say farewell to friends on a transatlantic steamer, but slipped into the sea while stunting. Lifeboats picked him up and the steamer carried him to New York before setting him ashore.

Honolulu, Hawaii. Six naval flyers sailed serenely over the Pacific in a two-motored flying boat. Without warning, both engines cut out. The pilot circled down through the clouds, saw he was over Hawaiian mountains, set the stabilizer, and ordered all hands to jump. The sextet landed safely in a pineapple field, followed by the ship, which came to rest a few feet distant on its giant hull, little damaged.

Manila, Philippine Islands. Consider this oddest of accidents in the aerial annals of the U. S. Army. Lieut. Fred-eric Glantzberg and Lieut. A. V. Anderson roared off Nichols Field to fly under-



Making a forced landing in a closed-course race, Harold Neuman turned his ship over in a pool of water. Six men lifted the plane and rescued the pilot.

A Few Examples of the Freakish Mishaps That Can Plague the Best of Pilots When Chance Rides in the Cockpit and Takes the Controls

By GROVER C. MUELLER

neath another Army ship trailing a long antenna carrying at its lower end a streamline lead weight. Through some mishap, the weight dashed across both cockpits, knocking out Glantzberg, striking Anderson in the eye. Convinced his companion was dead, Anderson jumped. After the plane had fallen uncontrolled for 1,500 feet, Glantzberg regained consciousness, landed, and then collapsed; his skull had been fractured by the blow on his head.

On several occasions, persons have been thrown out of airplanes while the pilots were stunting, or when the planes bounced or turned over in the air.

CENTRIFUGAL force threw Lieut. Neal Ansman out of the cockpit while he was stunting near Colon, Panama. He left the ship at an altitude of 6,000 feet, fell a third of a mile before recovering enough presence of mind to pull the rip cord, and another third of a mile before the 'chute billowed open.

A double tragedy of this sort is rare indeed, yet two persons have been tossed out of a plane together. Albert Myer and John Burwell were enjoying a morning spin over Massillon, Ohio, when their biplane dropped into a tail spin. So suddenly did the maneuver commence that both were hurled clear of the machine and dropped to their deaths. The plane headed, upside down, for the Massillon business district, then circled and dived into the earth near the bodies.

Many air accidents bring thrills without injury or death. Paul Bunker jumped from a disabled plane into a Florida swamp containing thousands of snakes. For three hours he waded among the reptiles and fi-

nally was rescued by a farmer in a canoe, jittery but unharmed. Milo Burcham was flying 1,000 feet above Tiffin, Ohio, when the propeller dropped off his biplane. He dived, circled, glided a mile, and skimmed over roofs, trees, and high-tension wires to land in a cow pasture, the only open space within several miles.

Airplanes, an autogiro, and two dirigibles came to the rescue of Arthur Rigney and a passenger after they were forced down in another Florida swamp twenty miles from the nearest road. Neither planes nor the autogiro could land. After five trials, the two men caught the railing around the gondola of one of the dirigibles and were lifted to safety.

The motor of Harold Neuman's tiny racing plane stopped in front of the grand stand during a closed-course race at New Orleans. In attempting to land, the plucky pilot missed the concrete runway, rolled into a pool of water, and turned over. Six men lifted the light plane bodily from the pool and pulled the young pilot from the cockpit, bruised but safe.

Insurance companies say that about one sixth of all accidents involving airplanes result from errors in judgment by the pilot, a sixth from engine failures, another sixth from some part of the plane itself giving way, and nearly half from foul weather. But at least two pilots have crashed because their legs were too long. In each case, expert examination revealed that the pilot had unintentionally jammed



Paul Bunker jumped from a disabled plane into a Florida swamp and floundered for hours among thousands of snakes

his knee against the valve which controlled the gasoline supply to the carburetor. Investigators recommended larger cockpits and cabins for lanky flyers.

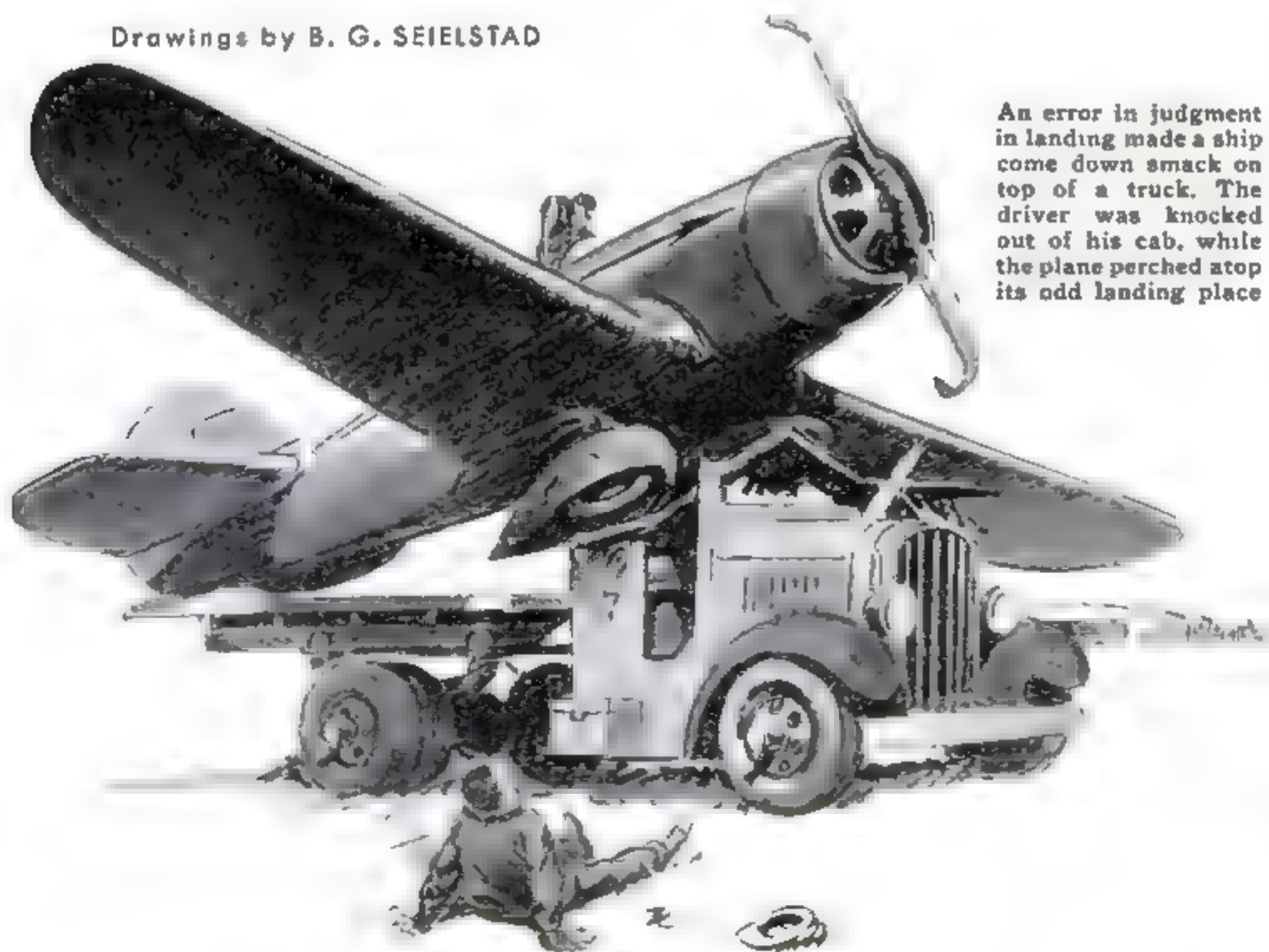
Some pilots experience miraculous escapes from seemingly certain death. An English dare-devil performing circus stunts flew his biplane upside down so close to the ground that his upper wing ripped the roof from a near-by car. The plane ricocheted into a river, and the pilot escaped injury.

At about the same time, an American pilot misjudged his distance to an eastern field and landed smack on a truck parked beside a highway, 100 yards from the center of the airport. The astonished chauffeur found himself sprawled on the ground, while the plane remained upright in this unusual landing location, its wings spreading weirdly above the body of the truck.

POWER lines, smashed by the impact of low-flying and falling planes, have caused some queer accidents. A. W. Burdette, out for a flight with two passengers near Madison, Wis., one morning, struck high-tension wires when coming down to land. He and his companions were saved, but James Wall, aged dairyman, was electrocuted when he touched a barbed-wire fence a hundred yards distant. The "hot" wires had fallen across the fence.

Carlyle D. Danty and Henry Sherman were more fortunate. In bringing his ship down at Hicksville, Long Island, Danty cleared a power line carrying 70,000 volts with the front wheels, but the tail wheel smacked into the wires. The plane swung like a pendulum, smashing down on one wing. The rubber tire on the tail wheel saved the airmen from sudden death from electrocution, and the big wing of the plane bore *(Continued on page 120)*

Drawings by B. G. SEIELSTAD



An error in judgment in landing made a ship come down smack on top of a truck. The driver was knocked out of his cab, while the plane perched atop its odd landing place

PLANTS GROWN IN AIR-TIGHT BOTTLES

RAISING plants on synthetic soil in bottles sealed against outside air, moisture, insects, and plant parasites, is the remarkable accomplishment of a Millburn, N. J., woman botanist. The artificial soil, which provides a scientifically balanced food for plants, consists of agar-agar, a seaweed derivative, combined with various chemicals. Poured into bottles, it congeals into a translucent, gelatinous mass. Seeds and spores are planted with a platinum needle and the glass containers are sealed with cotton wadding. In their individual,

sterile "greenhouses," the seeds rapidly develop into healthy, thriving plants. A moist atmosphere containing the essentials for plant life is maintained through the agency of the chemicals and the plants themselves; with each change of temperature, mist forms inside the glass and "rains" back on the plants. Given sufficient light, the plants will grow for years, or until they are too big for their containers, when they can be transplanted to larger bottles or to an outdoor garden. Delicate and rare plants are said to be easy to raise by this method and when transplanted outdoors, they prove exceptionally hardy. Because the chemical soil is nearly transparent, botany students can observe and study all the stages of root development.

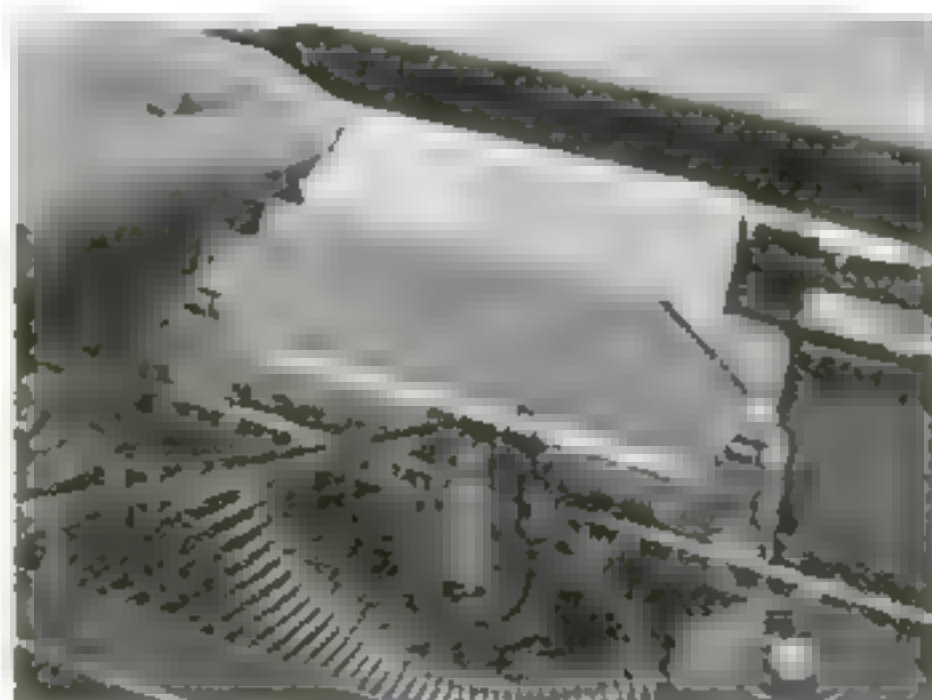
Bottled plant, in "rainstorm" caused by the condensation of moisture



Woman botanist using a photometer to check the light conditions for plants in synthetic soil

CARD HOLDER HELPS IN TYPING ON BOTTOM LINE

MAKING neat typewritten entries along the bottom margins of file cards, a task that ordinarily would tax the patience of a typist, becomes easy with the introduction of a flexible guide that holds a card steady and keeps it from slipping. When this accessory is rolled into the machine, it provides a secure receptacle into which the card may be dropped, and the typing is done through a slot. A graduated scale above the aperture of the holder serves as an aid in spacing the typing.



Card being typed through a slot in the holder

TRANSPARENT MATERIAL USED FOR BOAT SAILS

RACING dinghies and other small sailing craft can now be equipped with waterproof sails of a transparent cellulose material. Made from triple-ply sheets, said to be stronger and no more expensive than the best grade of racing sailcloth, the new sails are declared to be unaffected by rain or sea water and to retain their original shape despite severe weather conditions. The transparent sails can only be used on small boats, since they must be rolled up when not in use and cannot be folded or furled like ordinary sails.

COVERS KEEP GLOVES FROM GETTING WET

GLOVES may now share rainy-weather protection with shoes and clothing, for an inventor has come to their rescue with "overgloves" of oilskin. The waterproof coverings guard a good pair of gloves from the ravages of moisture and dirt, and are especially recommended for motorists.



EIGHT-WHEELED AUTO DEFIES SAND

The four front wheels of this novel car turn in unison for steering



Mud and sand offer no obstacles to an eight-wheeled car exhibited by a German inventor, since its multiple tread surfaces assure ample support and traction. The wheels are grouped in two sets of four each at the front and rear of the machine—an arrangement imposing an unusual mechanical problem in the design of steering apparatus. The inventor has overcome this difficulty by adapting the two forward pairs of wheels so that they swing in unison for making turns.

SPIRAL ROLLERS DRIVE ODD SPEED BOAT



CLEAVING the water at express-train speed, a propellerless power boat of new design may shatter existing speed marks if it fulfills the hopes of its West Easton, Pa., inventor. Its slim hull rides upon three buoyant, barrel-shaped rollers, of which the forward two are connected to the power plant and revolve at high speed. Helical fins, encircling them, sweep water astern and drive the boat forward. The water is also driven to each side, so that at high speed a trough is formed beneath the hull.

Outriggers shaped like airplane wings support the rollers and provide a lifting effect that aids the boat in skimming the surface. A freely rotating, fluted pontoon, that diminishes friction, supports the after end of the boat and a conventional rudder is used for steering.



Boat at Rest



Boat in Motion

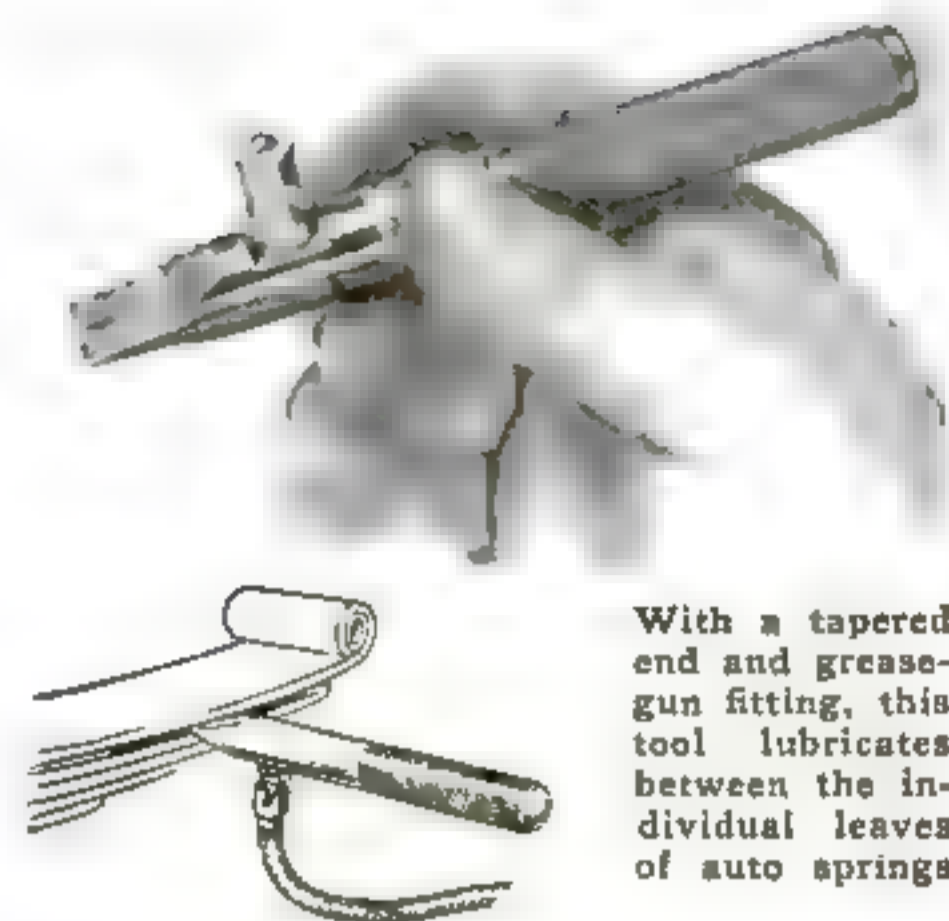
The small drawings show the roller-propelled boat at rest and under way. Note the trough formed under the hull when the boat is in motion

SPEED CAMERA OF NEW DESIGN HAS NINE LENSES

FLYING projectiles, speeding sound waves, explosions, and other incredibly rapid movements are photographed with a new high-speed camera developed by two German scientists. Nine lenses, mounted in three rows on front of the camera, are equipped with a specially designed mechanism to project separate and consecutive images of a moving object on a highly sensitive photographic plate. Each picture is snapped by the light of one flash of an electric spark lasting only one ten-millionth of a second. When developed and placed one behind the other in correct order, the nine separate photos show the phases of motion of a flying object as it streaked past in front of the lenses. The limit of practical value of the camera is reached at a speed of about 200,000 pictures a second. Scientific investigators will use the device to analyze and study movements too rapid for fast moving-picture cameras to catch.



The nine developed exposures, reading from top left to lower right, show the progress of a speeding bullet and a spreading sound wave. Above, a plate is being inserted in the camera



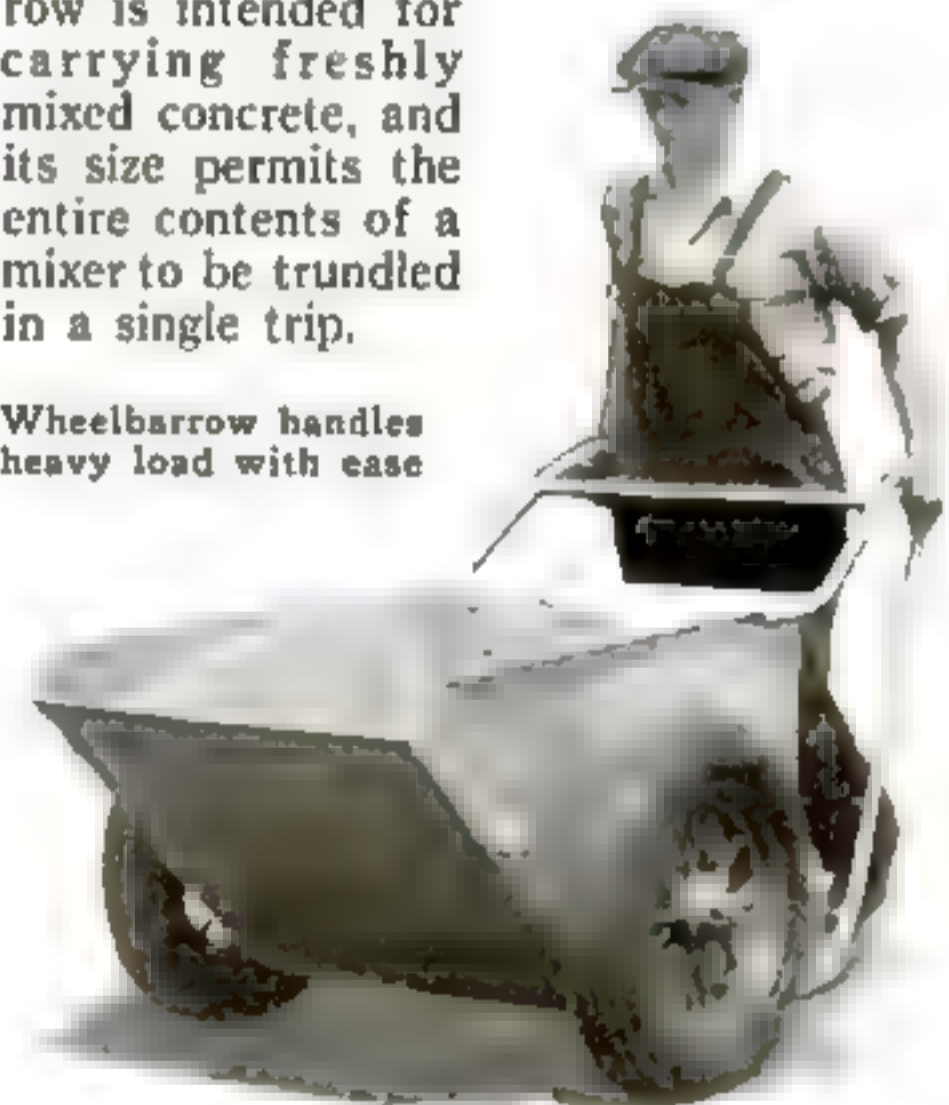
TOOL FORCES GREASE INTO AUTO SPRINGS

ELIMINATING squeaks in automobile springs is made easy by a handy greasing tool just placed on the market. The implement has a tapered end which is driven between the leaves of a spring. Then a grease gun, attached to a conventional fitting, forces grease into the device and out through a hole in its tip.

GIANT WHEELBARROW HAS ONE-TON CAPACITY

A WHEELBARROW that carries a ton may seem an implement more suited for giants than men, but such a device is now in practical use. Twin wheels steady it and rubber tires give it easy traction. One man, according to the maker, can handle it with no more effort than is needed for the ordinary type. The barrow is intended for carrying freshly mixed concrete, and its size permits the entire contents of a mixer to be trundled in a single trip.

Wheelbarrow handles heavy load with ease



ROUND CONCRETE HOUSES BUILT BY MACHINE

A ROBOT invented by an English engineer automatically constructs modernistic, round concrete houses which, the inventor believes, are destined to replace the square or rectangular homes of today. When workmen deposit materials in the machine, a mixer prepares concrete and feeds it into a pouring tube which slowly turns around a pole erected in the center of the spot selected for the dwelling. Concrete pouring out of this rotating tube forms the circular walls of the structure. The finished house resembles a giant round hat-box with windows and doors cut in the side.



AUTOS GET "RAINCOATS"

AUTOMOBILE "raincoats," just introduced in Germany, protect cars from the weather. Made of strong windproof canvas, the covers fit snugly over a car and extend down over the fenders to within a few inches of the ground. Parking lights and license plates are exposed to view through small windows cut out of the canvas at the proper places and covered with transparent material.



DWARF ROSE BUSH GROWS SIX INCHES HIGH

CALLED the "Tom Thumb" rose, a dwarf variety recently developed measures only six inches high when full grown. Its flower, starting from a tiny bud smaller than a grain of corn, unfolds into a perfectly formed, miniature bloom less than an inch across. The plants make novel table decorations.

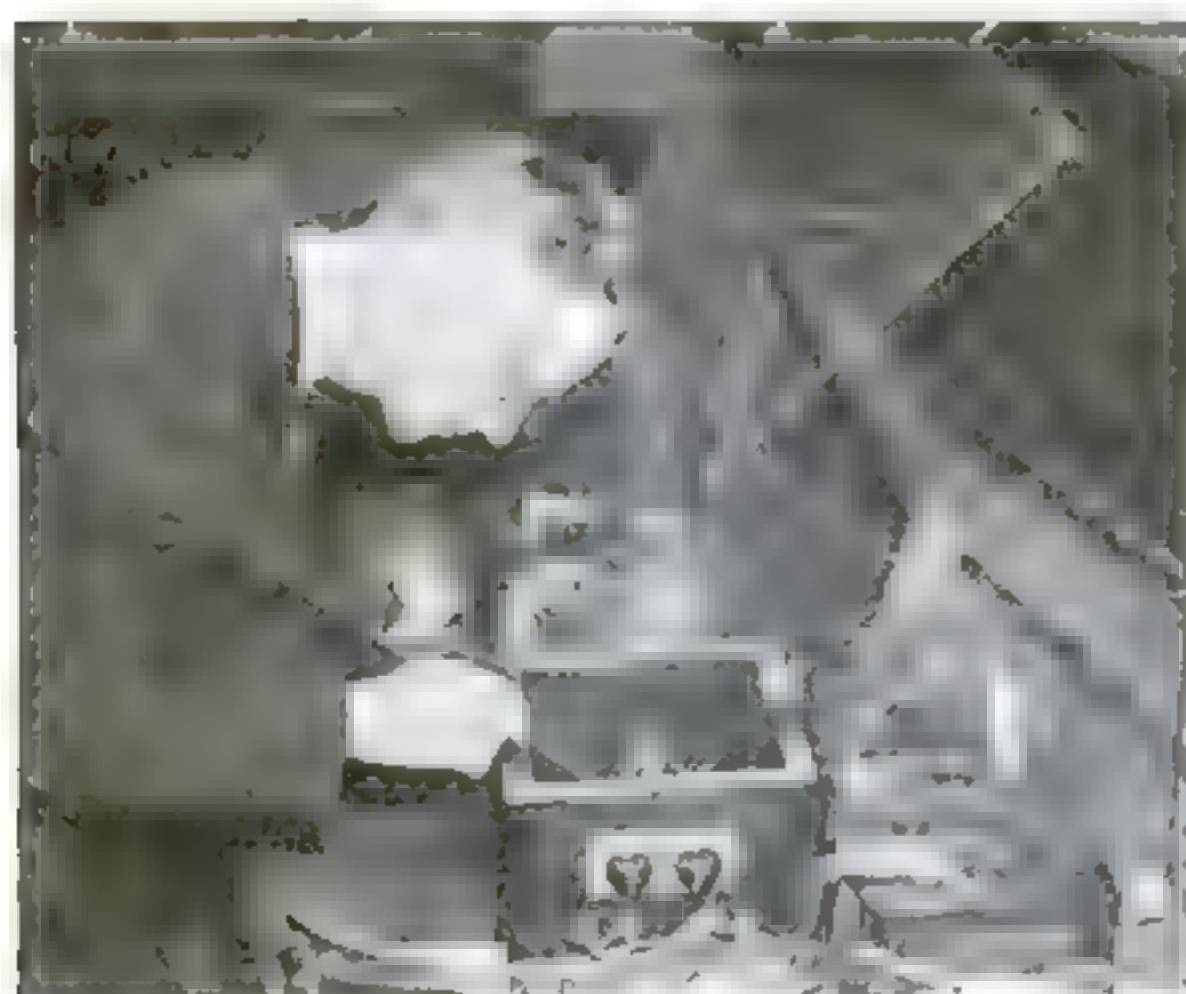
STATION WIRED FOR MUSIC

COMMUTERS hurrying through the vast main rotunda of the Grand Central railroad terminal in New York City are greeted by soothing strains of organ music from an elaborate sound installation just completed. Because of the peculiar acoustics, bands and orchestras in the huge room have always sounded tinny and unnatural. Sound engineers discovered, however, that electrically reproduced music, projected into the room through suitably placed loudspeakers, completely eliminated jarring, metallic echoes. Station recitals are now relayed from an outside organ studio, amplified, and broadcast through loudspeakers.



Loudspeaker installation in Grand Central Terminal, New York City. The inset shows the musician at the pipe-organ console in a distant studio.

PLASTICS GIVE SUBSTITUTE FOR GLASS



An expert testing a sample of transparent plastic material.

TRANSPARENT slabs of plastic materials are serving as panes for airplane windows, and may eventually find favor as a substitute for glass in other fields as well. While suitable plastics are somewhat more expensive than plate glass, and lack its resistance to weathering and scratching, they are only about half as heavy. Their flexibility is another important advantage in planes; since they may be bent to fit curved surfaces, air pockets are eliminated and wind resistance is reduced. Experts of the U. S. Bureau of Standards are conducting tests to grade the glass substitutes and to find how they can be improved further.



TIRE CHAINS FOR PLANES END TAKE-OFF SKIDDING

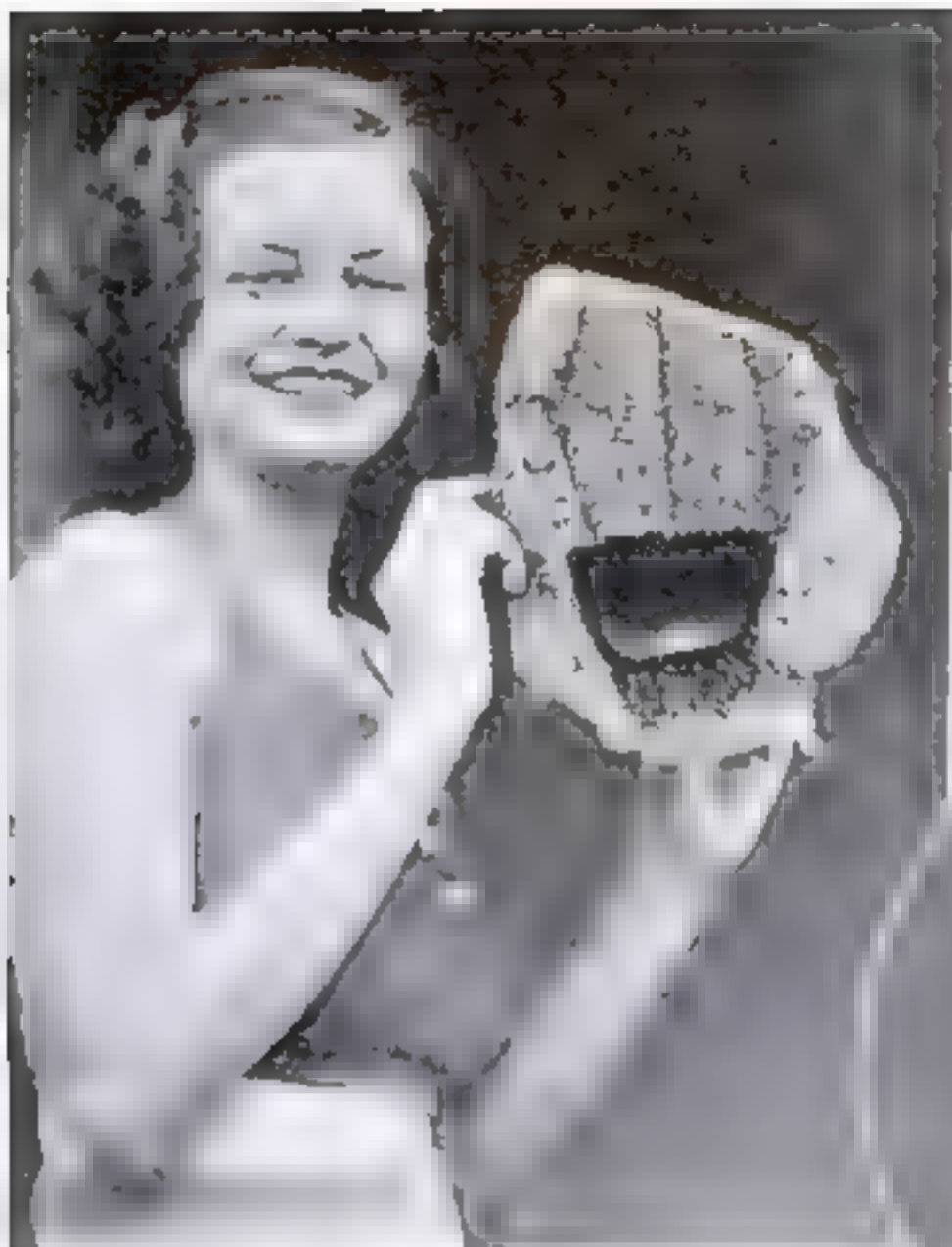
AIRPLANES, like automobiles, now use tire chains. Army mechanics tried the experiment of applying them to the rubber-tired wheels of a speedy biplane, during recent maneuvers, and found that they materially reduced skidding in taking off and landing upon a slippery field. Except in size, the chains resemble those used on motor cars and are attached in the same way. The simple expedient saves the time and labor that would be required for fitting aircraft with ski landing gear for temporary service on snow.

PORTABLE DOG PEN FOLDS COMPACTLY

A PORTABLE wire dog pen which conveniently folds into a small space has recently been placed on the market. The enclosure, composed of six wire grills hinged together, can be unfolded and set up in a few minutes. One section serves as a gate. The device is also adaptable for use as a play yard for small children.



Portable dog pen in use. One section swings out as a gate.



The beautiful interior of the swan flower, which emits a fragrance to lure insects. Right, a view of the bloom showing how it resembles a swan

INSECT-EATING FLOWER RESEMBLES A SWAN

ONE of Florida's strangest botanical curiosities is a flower that resembles a swan and depends for its food on its power to attract and trap insects. Lured by the delicate odor exuded by the strange coral-pink "swan flower," winged visitors crawl through an opening in the "stomach" of the plant.



Automatic trap nest and its inventor. He is holding the stamp device worn by hens



HENS "CHECK IN" FOR EGG-PRODUCTION RECORD

POULTRY RAISERS can keep accurate check on egg production with an ingenious automatic trap nest recently exhibited in New York, its inventor maintains. As a hen enters the nest, an inked stamping device fastened to her back registers her number on a paper tape, and her weight closes the door. When an egg is laid, it drops through rubber pads, touches a trip device which opens the nest door, and then rolls into a rack. The order of the eggs in the rack is the same as the order of the numbers on the tape.

NEW WOOL-LIKE FABRIC

WASTE from rayon factories can now be converted into a product resembling wool. Socks and dress goods of the new yarn have already been produced experimentally. The new material, it is reported, can be manufactured at only a fraction of the cost of natural wool.

COIN FLIPPER SHOWS HOW BODIES FALL

"HEADS" or "tails" shows up, at the will of the operator, when a coin is released from an ingenious device with which a British college professor impresses the laws of falling bodies upon his students. While the falling coin turns over and over at a constant rate, its downward speed is being accelerated by gravity. If a vertically adjustable platform is placed at just the proper point to take this into account, the coin infallibly comes to rest upon the platform with "heads" uppermost. With a slight change in the adjustment of the platform, "tails" will always appear.



Student watching coins fall "heads" or "tails" as desired

AIR TOWER AIDS ASTHMATICS

TO SHIELD asthmatic patients from the irritating effects of molds, pollen, and other dusts that float in the air immediately above the ground, a German sanatorium utilizes a 200-foot ventilation tower with an intake at its top. Dust-free air, sucked from the upper levels of the atmosphere, is pumped through an elaborate system of pipes into glass-lined, hermetically sealed bedrooms.



Tower with air intake outside a German sanatorium. At left, asthmatic patients breathing clean "upper air" piped into their room



FAN HAS RUBBER BLADES TO PREVENT ACCIDENTS

BLADES of rubber, in a new "accident-proof" electric fan, make a metal safety guard unnecessary. The vanes are declared flexible enough to prevent injury if hands or fingers come in contact with them while they are moving, yet have sufficient rigidity to deliver a strong current of air. The curious shape of the overlapping blades is said to make the fan unusually quiet.

Nature's Factories

BACTERIA, YEASTS, AND MOLDS PRESENT
FASCINATING SUBJECTS FOR EXAMINATION

By MORTON C. WALLING



Test-tube rack with cultures grown under a bell jar

WHEN the modern engineer or scientist speaks of a chemical factory, he usually is thinking of a huge brick or steel building containing an impressive array of distilling equipment, tanks, machinery, and other things. But nature, ages ago, perfected miniature chemical plants which make man's manufacturing efforts seem crude. Indeed, a number of modern industrial processes make use of these age-old chemical factories.

To see the midget chemical factories of nature, you need but turn to your microscope. Although there are a great many organisms in both the animal and plant kingdoms which make use of chemistry, we will consider here only a limited group, mainly some of the fungi, those plants related to and including toadstools and mushrooms. The group comprises also yeasts and molds, to which we will add bacteria.

It seems as if human chemists had imitated these midget factories to an ex-

cessive degree. Much of modern chemistry is devoted to the betterment of our lives, yet there are other chemical activities, such as the manufacture of poison gases for use in warfare, which are definitely destructive. In the same way we find, with the aid of the microscope, that the chemical plants of the invisible world can be divided into two groups: Some are engaged in honest, beneficial

work, while others seem only to exist for the purpose of destruction. Bacteria, for instance, are not all harmful. Growing in the roots of alfalfa and certain other plants are tiny organisms which take nitrogen that once was a free gas in the air and convert it into nitrogenous compounds which benefit the soil. In the manufacture of vinegar a tiny plant known as *Bacterium aceti* is necessary to convert the alcohol in hard cider into acetic acid. The acid may be distilled, if desired, from the vinegar.

These are examples of the good bacteria. Among those with more shady reputations are disease organisms, bacteria which cause

the production of food poisons, and so on. The poison-gas makers of so-called civilization have their counterparts in the bacterial world. Did you ever see a can of badly spoiled peas or beans with the ends of the can bulged out as if some one had pumped the can full of air at high pressure? The bulging came from compressed gas generated by bacteria acting on the food. Never eat food from a can that exhibits this bulging, or one which spurts its contents instead of drawing air inward when it is opened. It happens that some of the most deadly poisons known are produced by bacteria which may be pres-



A sample of bread mold being collected from a piece of moist bread where it grew



1 The first step in preparing a bacteria slide is to place a smear of the specimen on a clean glass slide and dry it by passing the slide through a gentle gas flame



2 To fix the bacteria, let a drop or two of alcohol fall on the slide and spread around the smear. Touch a lighted match to it, and the flame will fix all bacteria there



3 Place one or two drops of staining solution on the area that contains the specimens. After it has acted for a few minutes, wash it off with water and dry the slide



4 After treating with alcohol to remove excessive staining, apply a drop of Canada balsam to the slide and lay over it a clean cover glass, preferably a thin one

REVEALED BY YOUR Microscope

ent along with the gas-producing decay organisms.

Chemical plants in the yeast field are, for the most part, either beneficial or only mildly undesirable. Perhaps the best-known members of the yeast family are those whose lives have been dedicated to the making of alcohol and alcoholic beverages. Known commonly as brewers' yeasts, these tiny plants, considerably larger in size than their relatives the bacteria, have been babied and nursed and cultivated for centuries, until today they are highly domesticated in comparison with the so-called wild yeasts.

Fermentation is a chemical process caused directly or indirectly by organisms, either animal or vegetable. Yeast is the most common organism used by man for this purpose. Its tiny cells have the power to secrete within themselves two enzymes—very active chemical substances. These enzymes have the power of converting sugar into alcohol and carbon dioxide gas. In this manner, yeast added to bread dough converts the sugar in the flour into alcohol and carbon dioxide. Bread becomes porous because of the expansion of these products.

The third group of microscopic chemical plants are the molds. These for the most part have bad reputations because they cause food to spoil, attack various materials and weaken them, become bothersome when growing in photographic processing tanks, attack growing plants and fruits, and cause various diseases in man, such as certain respiratory infections. Some molds are beneficial because they help form humus, the important organic soil material. Molds and bacteria extract nitrogen from dead plants and animal droppings and from them make ammonia and nitric acid which can be used as food by growing plants.

It is not difficult for the amateur microscopist to see and study these fascinating chemists. They are easy to find and not at all difficult to prepare for observation. The bacteria and yeasts require, for the most part, magnifications of 400 or more diameters, although some of the larger kinds can be seen at 100 diameters with good lenses. With the cheapest microscopes, it is not easy to see bacteria and yeast plants at any magnification.

While you can cultivate bacteria on beef-broth jelly and similar media, and obtain colonies of them large enough to see with the unaided eye, you can obtain all the specimens you want by simpler means. A drop of stagnant water; a smear of milk, preferably sour; a little buttermilk; a speck of decayed fruit; any of these will provide bacteria in abundance.

To prepare a slide of stained bacteria is a matter of minutes, after you have become familiar with the routine. You desire, for example, to see what manner of chemical plants are present in a drop of buttermilk. Scour a one by three-inch microscope slide, or better still, three or four of them, and wipe clean with a cloth. Heat the slides *(Continued on page 110)*

Test-Tube Rack Fits Under Bell Jar

TEST tubes make convenient containers in which to handle various cultures. If this method is followed, a test-tube rack becomes almost indispensable. A handy rack for this purpose, illustrated here, is easily made by the amateur microscopist.

Obtain two two-foot lengths of one-quarter-inch hard-wood dowel stock, sufficient oak, maple, white pine, poplar, redwood, or cypress to make three disks measuring about one half inch thick and five and three quarters inches in diameter, a few brass nails or escutcheon pins, and a quantity of waterproof casein glue.

Cut the disks to the desired diameter and smooth the edges with sandpaper. Clamp all three of them to a faceplate. Remove the centers from two of the disks so as to leave a ring measuring one and one eighth to one and one quarter inches between outer and inner circumferences. Leave the third disk solid.

The rack shown here has an overall diameter of five and three quarters inches and fits inside a bell jar made from a one-gallon jug (see photograph on opposite page). In boring the test-tube holes, clamp the two disks together and bore through both at once. It is best to trace the design on paper and fasten this temporarily to the rings.

After the tube holes are finished, clamp the three circular pieces together and bore holes for the five dowels which act as spacers. The holes are spaced one between each group of three tube holes.

In the center opening of the rack can be glued a dozen pegs for holding tubes while they drain. These are spaced as shown. The pegs are $3\frac{1}{2}$ -inch lengths of one-quarter-inch dowel stock, which



The rack in use. The experimenter is dropping a piece of yeast cake into some dilute molasses

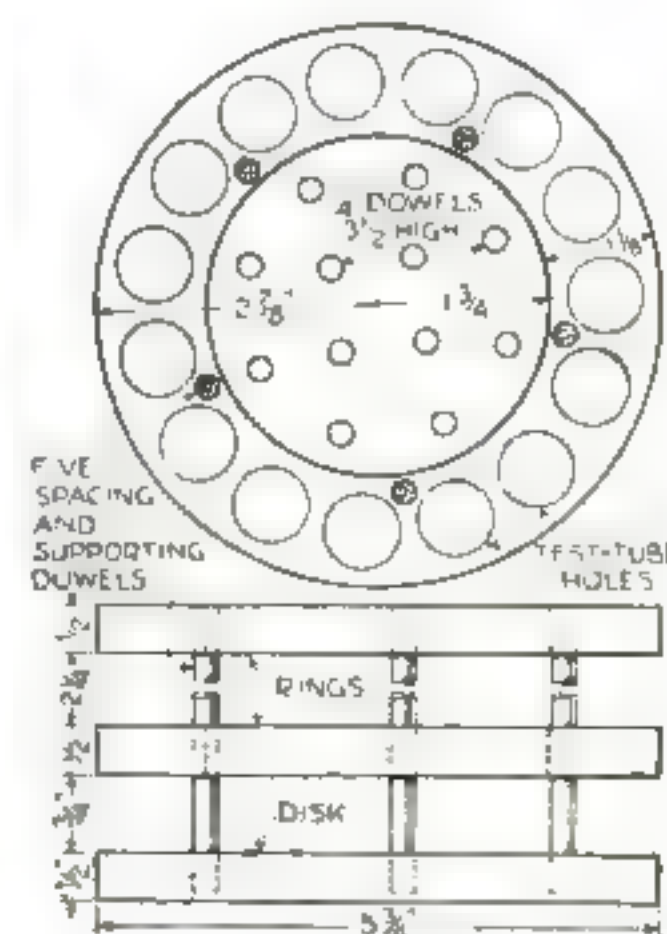
project three inches above the one-half-inch base piece.

The wood can be left unfinished, may be coated with waterproof paint or varnish, or treated with linseed oil. However, you probably will not find a finish that will resist alcohol, xylol, and other chemicals completely.

To make a bell jar from a one-gallon jug, fasten a glass cutter on a half-inch-block, with the cutting wheel held horizontally. Set the jug on the same surface that supports the cutter block and, by moving either the block or the jug, scribe a line completely around the side. Bend a piece of one-quarter-inch rod into a sort of hammer and tap the glass gently on the *inside*, opposite the scribe line. The bottom will separate cleanly if the scribing and tapping have been properly done. Bind the sharp edges with adhesive tape and insert a cork in the top.

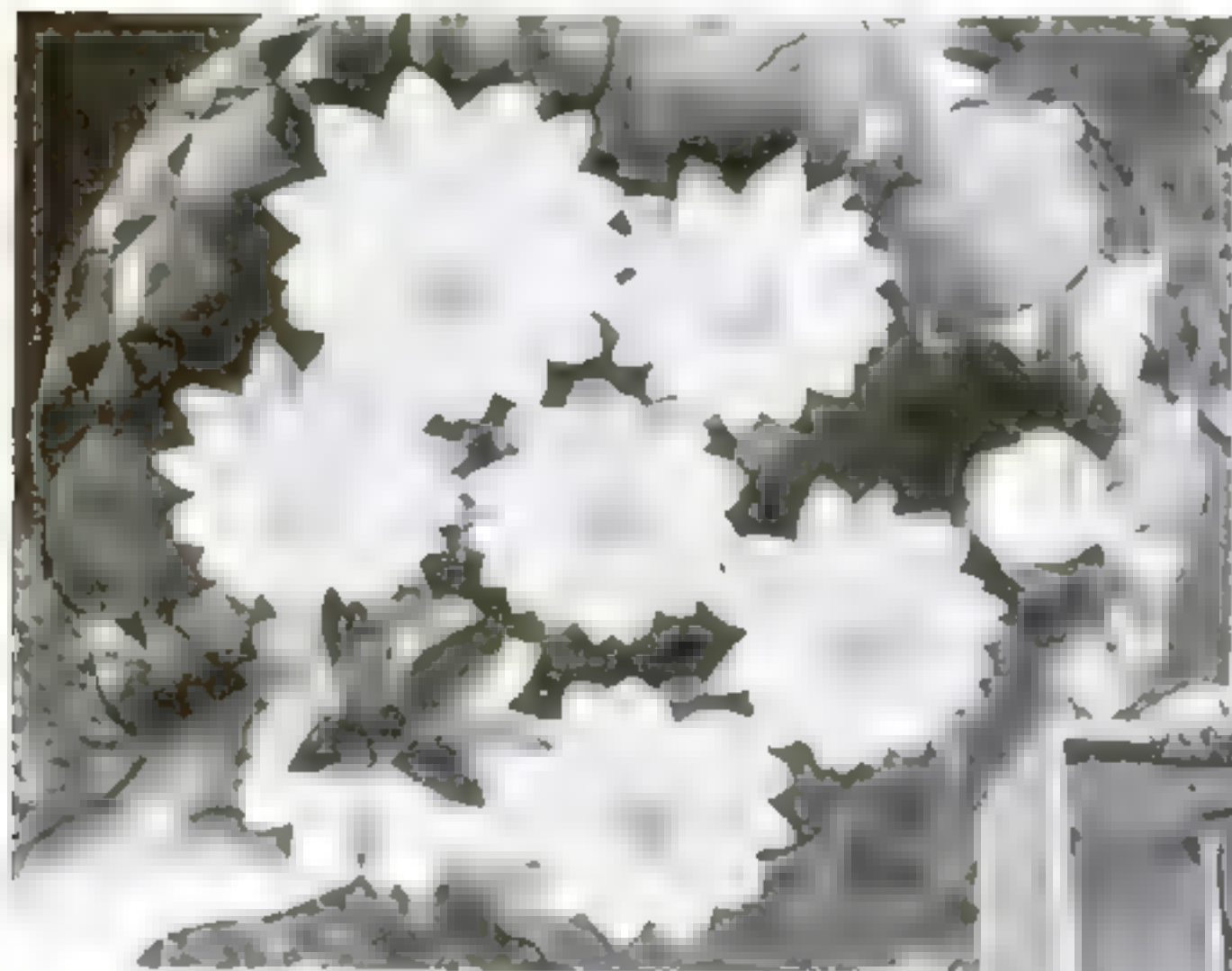


Parts of the circular test-tube rack being assembled. The pins are quarter-inch maple dowels. The drawing at right shows the layout of holes, and how the parts go together



RAISING Water Lilies

IN A Back-Yard Pool



Water-lily blooms as they appear when prepared for display in the home. The stems are cut close to the flower and floated on the surface of water in a bowl

AN INFINITE variety of rainbow hues are now available in water lilies. The blooms,—white, carnation, coral pink, orange, blue, cerise, apricot, royal purple, yellow,—range from dwarf flowers the size of a quarter to giants more than a foot across. Without requiring weeding or watering, they provide color and fragrance throughout the summer.

Any back yard open to the sunshine is suitable for a lily pool. The aquatic plants, however, do not do well in the shade. So, in planning your water garden select a spot where the sun will reach it as much as possible. Never put the pool under a tree or in the shade of tall structures.

The best depth for your pool is about two feet. The bottom should be flat, with the walls slanted back just enough to take care of ice, causing it to rise as it expands instead of cracking the concrete. A slant of two inches in two feet is sufficient.

The lilies do best if planted in roomy boxes. They never thrive in pots or small containers. The ideal box, according to Mrs. L. Helen Fowler, head of the famous W. B. Shaw Aquatic Gardens, Washington, D. C., is two feet square and one foot deep. Made of three-quarter-inch pine shelving material, the boxes should have a crack or holes in the bottom to let water seep through. Otherwise, the fertilizer inside will ferment.

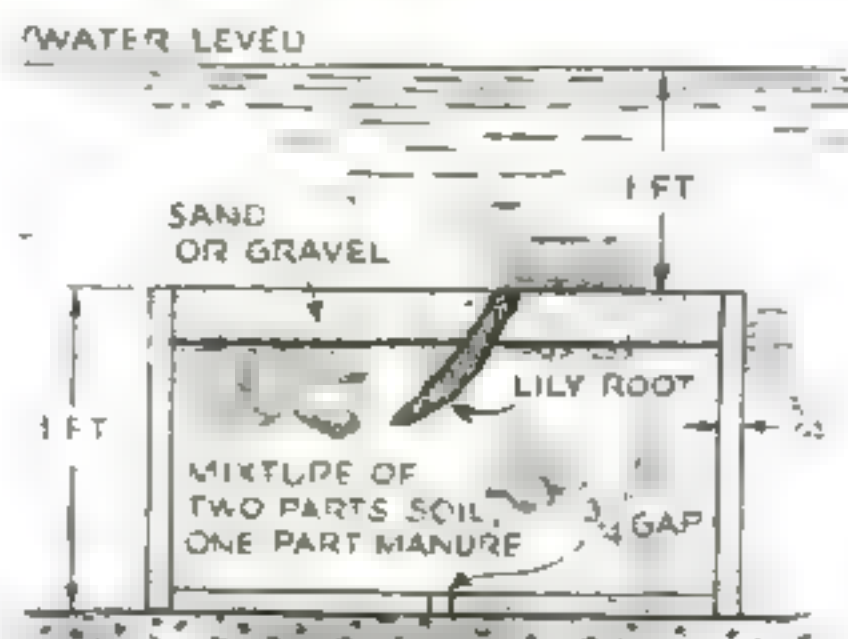
Almost as soon as you can work comfortably in the water of a pool, you can set out new plants. The season for the hardy varieties begins about the first of May and roots will establish themselves if they are put in a pool as late as the first of August. Tropical lilies are more deli-

A box for holding lily plants in a pool. It has a crack in the bottom to permit seepage

cate and their planting season begins about the fifteenth of May or the first of June.

The first step is filling the boxes with a mixture of good garden soil and well-rotted cow manure in the proportions of two to one. Tamp this down until it is packed firmly in the box. Then scoop out a hole in the center with a trowel. Place the lily root in it at an angle of forty-five degrees, with the crown level with the top of the box. Clean sand or gravel should form a layer from one to two inches thick over the top of the soil.

Only one plant should be put in a box. If the pool is two feet deep, the boxes can be placed on the bottom, as this will



LAYOUT FOR GARDEN POOL

Cross section of a small pool, showing how the plants are bedded in boxes under the water



Harvesting blooms in a commercial lily pond. Flowers are gathered in the morning for shipment

bring the crown of the lily root within twelve inches of the surface. If the pool is deeper, bricks should be put under the boxes to raise them. Never should the plants be placed with the crowns lower than from nine to twelve inches below the surface of the water.

A pool eighteen feet long and eight feet wide will accommodate seven boxes. By the spring of the third year, the plants will have multiplied so that the extra ones must be discarded or transplanted into other boxes.

In small yards, where large pools are impossible, a clean wooden tub or part of a hogshead will provide a place for water lilies. Such miniature pools should be sunk until the rims are flush with the lawn, then filled half full of a mixture of earth and manure. If they are not more than two feet deep, the roots can be planted directly in this packed soil, about five water lilies going in a single tub. Sometimes, several small pools can be arranged to add to the attractiveness of a yard.

One word of caution: Use wooden tubs, never galvanized or coated tanks. Water lilies do not thrive in metal containers.

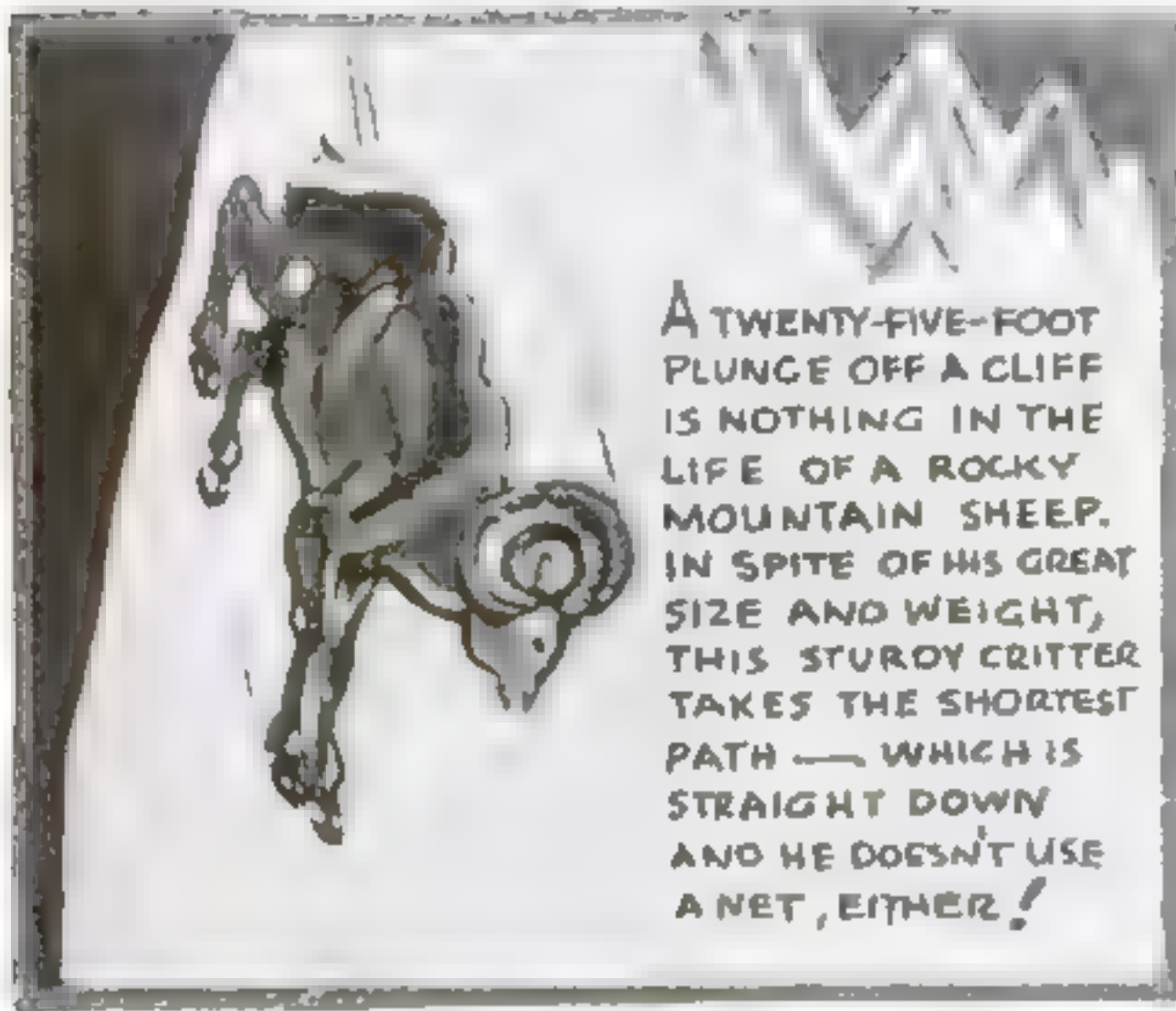
Frogs and goldfish not only add life to a water garden but they destroy insects and mosquito larvae. One pest they cannot control, however, is the small green worm known as a "channeler" or "leaf miner." It tunnels its way within the broad lily leaves and produces disfiguring brown trails. To eradicate this pest, use any good garden spray which will not stain the leaves or discolor the water.

In cutting the flowers for home display, clip the stems close to the base of the bloom instead of leaving them long as in cut roses. The flowers are then floated, petals up, in water in a shallow bowl.

Unless you live in a part of the country where ice reaches a thickness of more than ten inches, you can leave your hardy lilies out all winter. Tropical varieties should be brought indoors and stored in a cool part of the cellar in wooden boxes filled with slightly damp earth.

Un-Natural History

By
GUS MAGER



A TWENTY-FIVE-FOOT PLUNGE OFF A CLIFF IS NOTHING IN THE LIFE OF A ROCKY MOUNTAIN SHEEP. IN SPITE OF HIS GREAT SIZE AND WEIGHT, THIS STURDY CRITTER TAKES THE SHORTEST PATH — WHICH IS STRAIGHT DOWN AND HE DOESN'T USE A NET, EITHER!

THE MUSEUMS ARE CATCHING UP WITH NATURE! THEY NOW EXHIBIT MAMMOTHS' TUSKS CURVED THE RIGHT WAY, INWARD AND NOT OUTWARD, AS WAS CONSIDERED THE CORRECT STYLE UNTIL RECENTLY



THE KEA OF AUSTRALIA, A HARMLESS VEGETABLE-EATING PARROT, HAVING GOT A TASTE OF FROZEN SHEEP FAT AT THE RANCH HOUSES DURING WINTER, SOON CHANGED INTO A MURDEROUS BIRD OF PREY AND ATTACKED LIVE SHEEP!

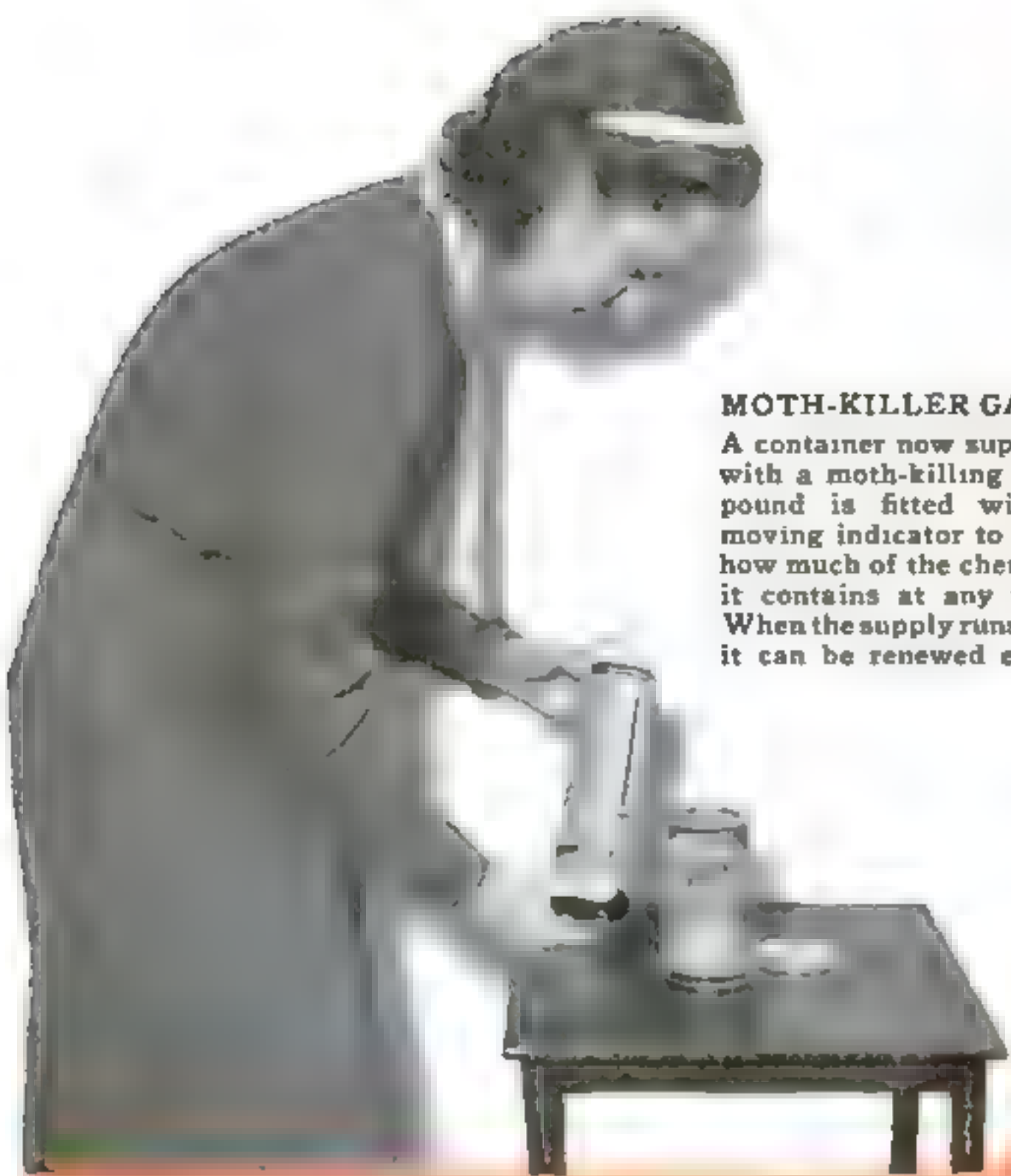
THE ASTOUNDING DUNG-BEETLE MOTHER, WHO ROLLS BALLS OF DUNG TO HER NEST, AND SPENDS 4 MONTHS, WITHOUT FOOD, DOWN IN HER BURROW, FEEDING HER INFANT BROOD, AND ATTENDING THEIR WANTS. JUST A POOR INSECT!



THE TASMANIAN WOLF — A TRULY FEROCIOUS AND MERCILESS KILLER OF THE NIGHT. WITH A WOLF'S HEAD, AND STRIPES LIKE A TIGER ON THE BACK, THIS BEAST CARRIES ITS YOUNG IN A POUCH LIKE THE KANGAROOS.



AND THIS IS A GRAPE VINE? YES, INDEED, THE LARGEST IN THE WORLD — GROWING TODAY IN SANTA BARBARA COUNTY, CALIFORNIA. ITS TRUNK HAS A CIRCUMFERENCE OF EIGHT FEET, AND ITS BRANCHES COVER HALF AN ACRE! TEN TONS OF GRAPES IT YIELDS EVERY YEAR. NOT EXACTLY A CLINGING VINE, IS IT?



MOTH-KILLER GAUGE

A container now supplied with a moth-killing compound is fitted with a moving indicator to show how much of the chemical it contains at any time. When the supply runs low, it can be renewed easily

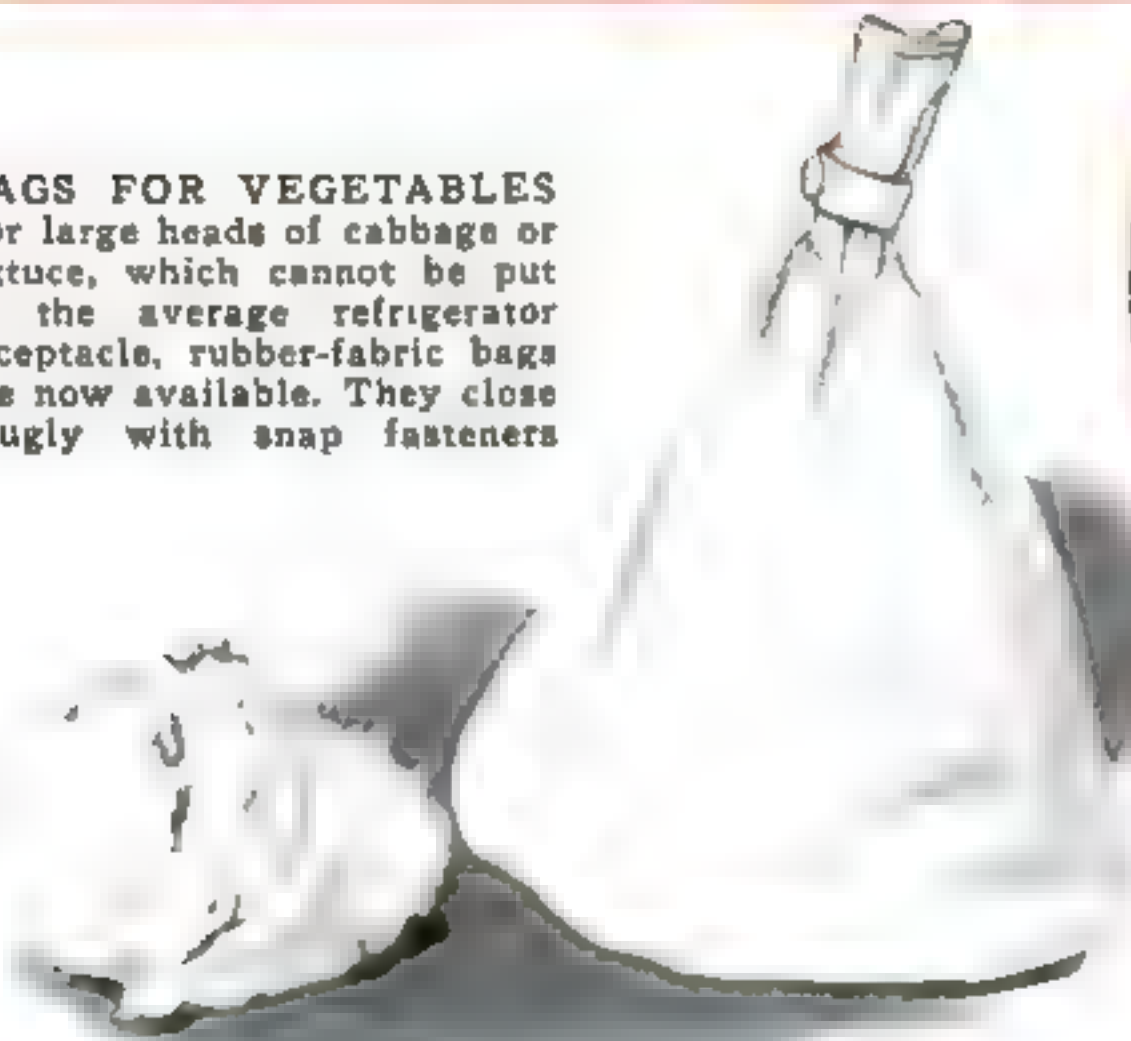


PHONE CORD IS FLAT

A new flat, rubber-covered phone cord simplifies the problem of laying wires under rugs. The conductors are separately insulated to permit passing through holes

BAGS FOR VEGETABLES

For large heads of cabbage or lettuce, which cannot be put in the average refrigerator receptacle, rubber-fabric bags are now available. They close snugly with snap fasteners



THREE-IN-ONE ACCESSORY. The handy electrical device illustrated above can be used as an iron, as a curling-iron heater, and for cooking simple dishes. The heating element in the iron serves for all three purposes

FOOD-GRINDER RACK

To keep old-fashioned food grinders from marring modern kitchen shelves or tables, a special detachable rack now available fits into a bracket mounted under the ledge, as shown below. The grinder clamp harmlessly grips a sturdy wood block built into the rack

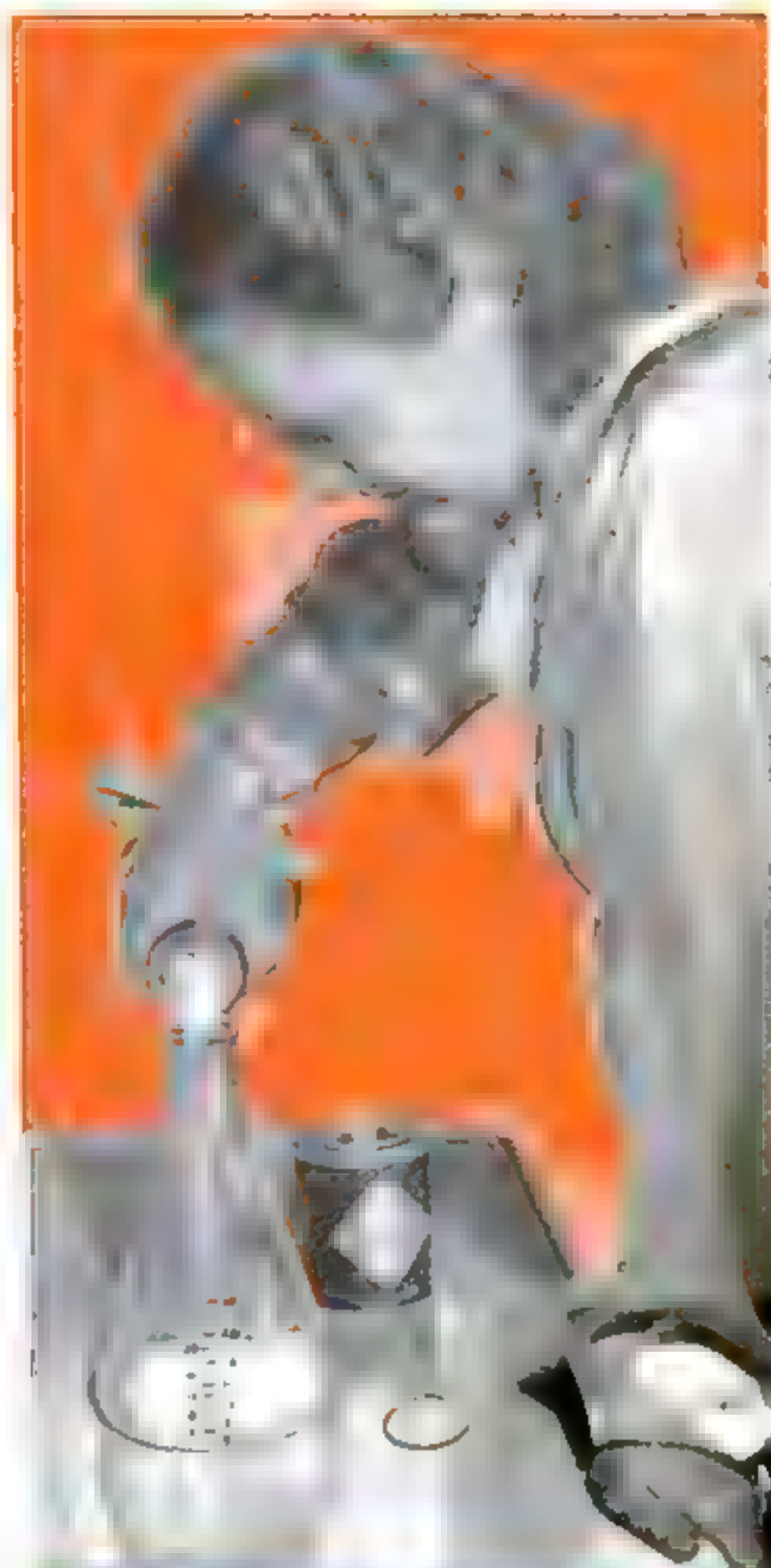


COOKER ELIMINATES BASTING. Meat juices collect in the bottom of this roaster and are forced up through a percolator tube to a glass top from which they sprinkle on the meat, thus continuously basting it and saving the housewife this trouble

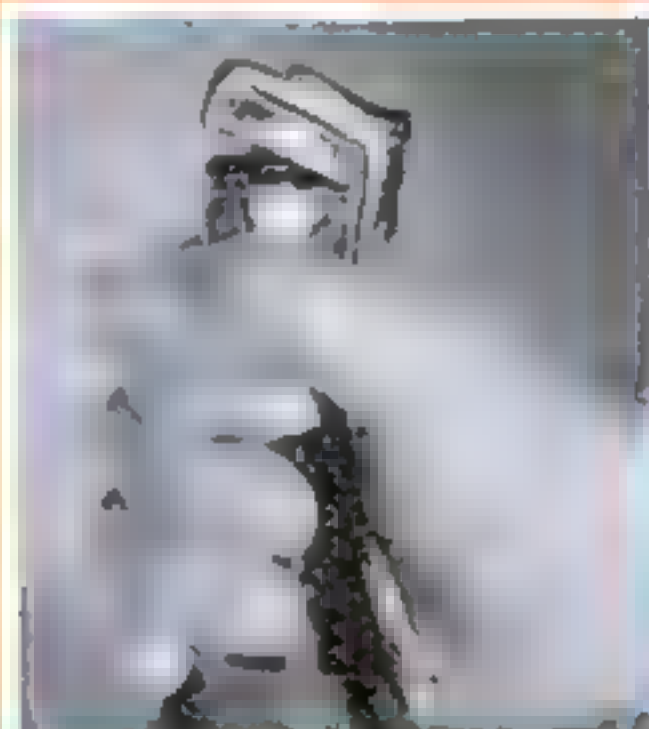
Handy Aids for the HOMEMAKER



MUSICAL SHOWER CURTAIN. For the benefit of bathroom baritones and tub tenors, shower curtains are now supplied with a suitable musical selection printed upon them. The words are of a humorous character, and the musical notes are interspersed with amusing drawings. The curtains are made of a rubberized fabric



SANITARY BOTTLE. Made of heat-resisting glass and marked with a graduated scale, this bottle can be used for measuring and boiling water or milk, and will keep formulas sterile



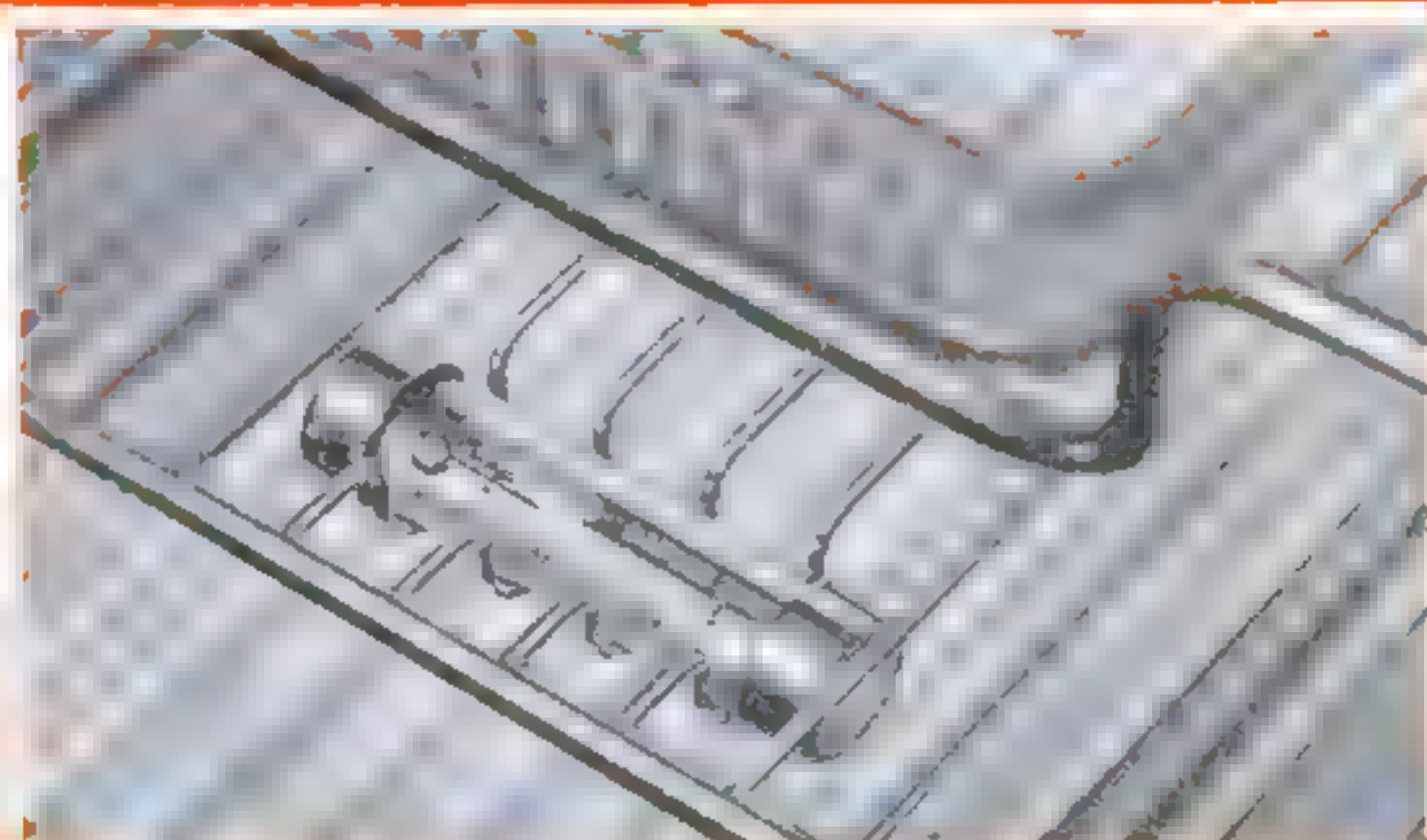
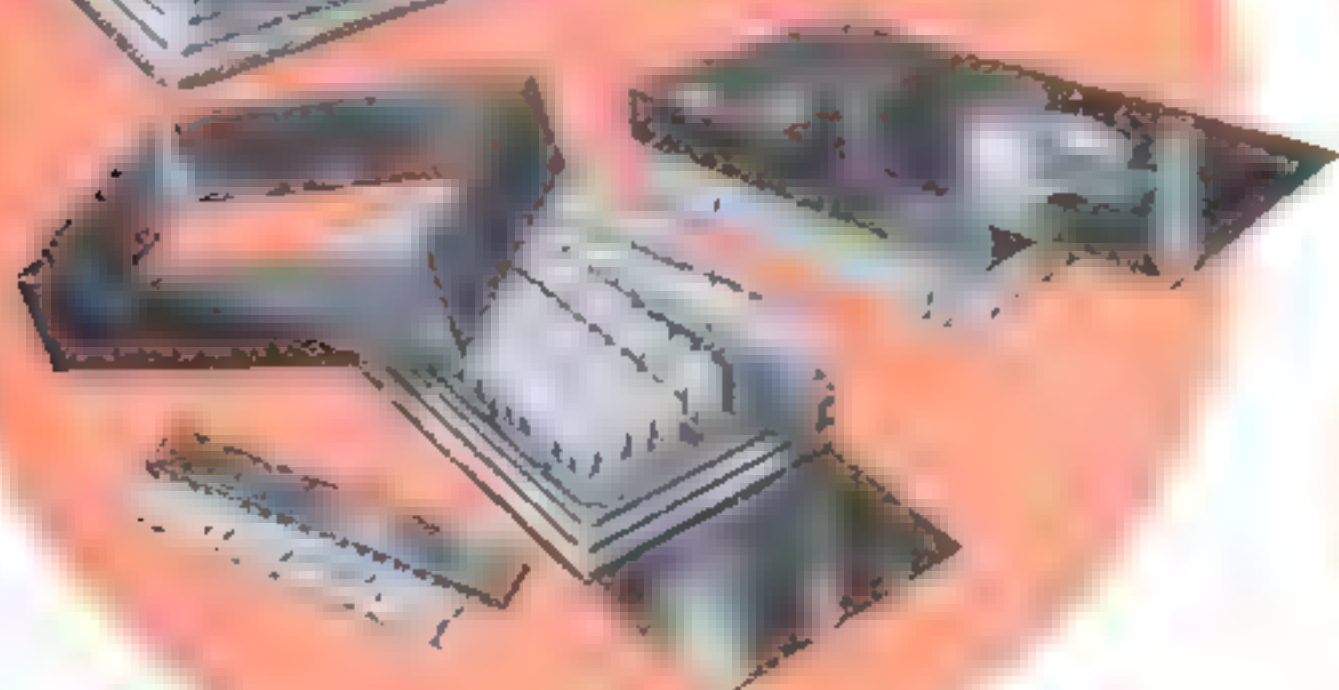
OPENS BOTTLES BY SQUEEZING. When the gargoyle beak of a new bottle opener is placed over a bottle cap, and the curved handle is squeezed against the bottle neck, the cap comes off easily without flying



SOAP GRINDER
Odd pieces of soap, which usually go to waste, can be reclaimed by means of the hand mill illustrated at the left. Screwed to the wall and operated with a crank, it turns soap into powder for dishwashing or laundry



SECTIONAL BRUSH
Made in sections, each of which consists of a separate row of bristles, the brush shown at the left is readily taken apart for cleaning or replacement. The sections are held together by a frame



SHOWS REFRIGERATOR TEMPERATURE. Set in a recess in a tray of an electric refrigerator, this tiny thermometer shows at a glance the temperature of the food compartment. The scale is divided clearly into three critical zones

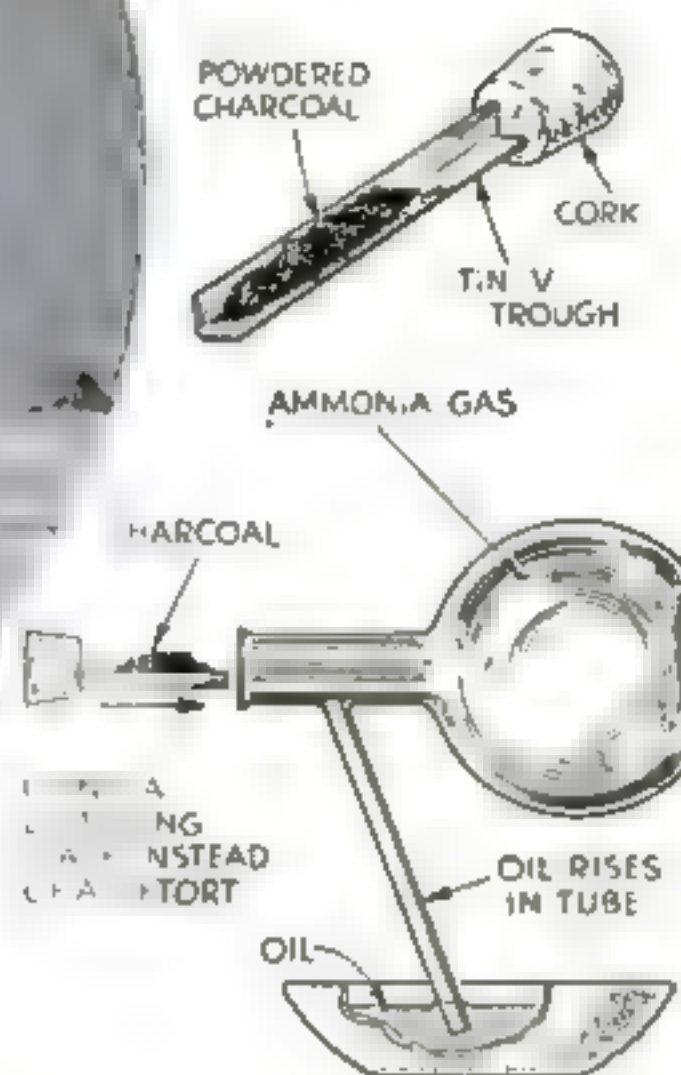
Experiments with Gases

EXPLAIN MYSTERIES OF ADSORPTION

By Raymond B. Wailes



Heated charcoal introduced into a retort filled with ammonia gas adsorbs the gas, causing oil to rise in the stem of the retort. A flask may be used if no retort is available



til the rinsings no longer show the slightest color. At this point you might reasonably suppose every trace of the dye to be removed. Actually, however, the glass wall of the bottle has adsorbed some of the dye and is still clinging to it tenaciously. This may be demonstrated by pouring some alcohol, in which the dye is more soluble, into the bottle and agitating the liquid for a few seconds. The alcohol takes on a pronounced violet color, showing that it has released from the glass the adsorbed dye. The effect will be still more striking if the original water solution is left in the bottle for several hours before it is discarded. Either pure or denatured alcohol may be used for this experiment.

Some substances, especially gases, adhere so strongly to solids that they cannot be removed by so simple a "de-adsorption" method as washing with alcohol. To create a vacuum in electric-lamp bulbs and radio tubes during their manufacture, for example, it is not sufficient merely to pump the air out. The bulbs or tubes have to be heated in an oven to drive off the thin film of air and water vapor that has been adsorbed by their inner walls. In addition, small amounts of substances known as "getters" are introduced, and these, when heated, combine chemically with the residual gases and help to produce a vacuum.

To visualize how a "getter" works, suppose that a piece of metallic magnesium was placed in a test tube of oxygen and ignited by heating the outside of the tube

WHEN a soldier dons a mask for protection against poison gas, he is intrusting his life to a canister of air-purifying chemicals of which one of the most important is charcoal. It removes toxic vapors and helps make the air fit to breathe by virtue of a curious phenomenon with the misspelled-looking name of adsorption, which you will find interesting to investigate in your home laboratory.

Adsorption is said to occur when gases or dissolved materials are trapped by the adhesion of their molecules to the surface of a solid substance, as if it were a sort of chemical fly paper. Many solids can hold a surprising amount of foreign matter in this way. One typical variety of wood charcoal, for example, will take up nine times its own volume of oxygen gas; thirty-five times its own volume of carbon dioxide gas; and as much as ninety times its own volume of ammonia gas.

Charcoal and ammonia, then, should give an especially striking demonstration of the phenomenon of adsorption of a gas. A convenient way to make the ammonia gas is to heat gently a solution of an ammonium chemical that has been mixed with an alkaline solution. For the former chemical, ammonium chloride (sal ammoniac) or ammonium sulphate may be used; both are inexpensive and easily obtained. Ammonium sulphate may be purchased at seed and garden-supply stores, since it is used as a fertilizer. The alkali may be sodium hydroxide (ordinary lye).

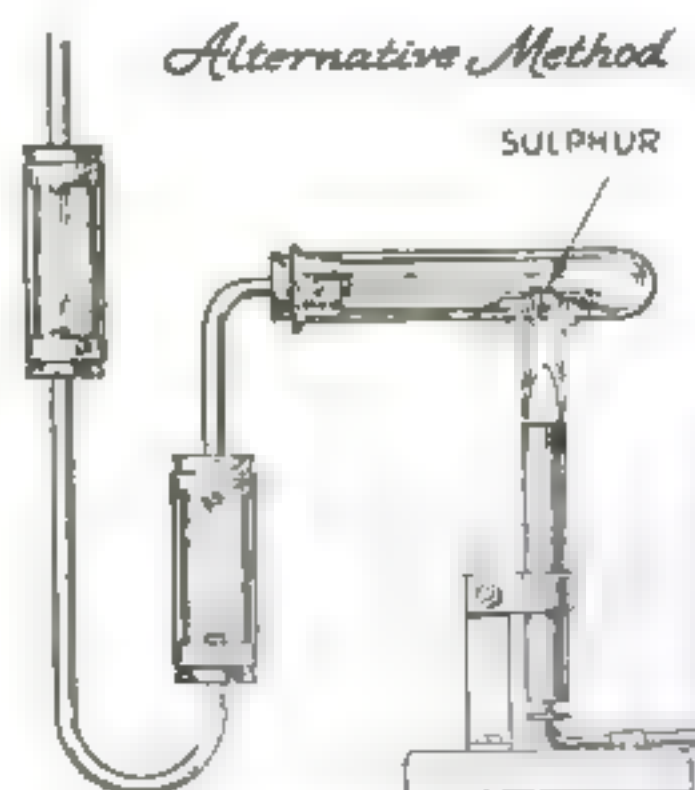
Fill a retort or a flask with ammonia gas from your generator, remembering that the gas is lighter than air and that the vessel should therefore be held mouth downward while being filled. When the ammonia gas has had time to sweep out the air,

which will not take long if the delivery tube leads right into the enlarged portion of the vessel, lower the tubular end of the retort or flask into a small dish of oil. Machine oil or any other kind of light oil will be satisfactory, but water cannot be used as it would dissolve the ammonia.

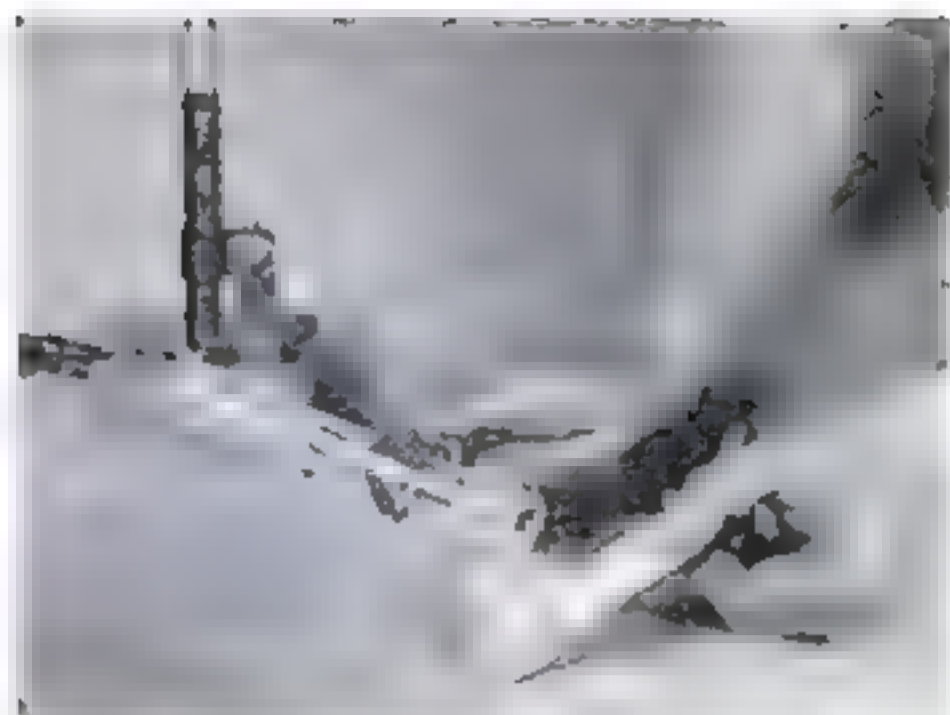
A handy aid to manipulation in this experiment is a stopper with a V trough fitted to its small end, making it possible to introduce the charcoal and stopper the vessel simultaneously. The powdered charcoal should previously have been heated, in a small porcelain crucible or evaporating dish.

Now, if you put some of the charcoal in the vessel, you will see the oil begin to rise in the tube that dips into the dish. As the charcoal removes the ammonia by adsorption, the pressure of the exterior atmosphere raises the oil to a height depending upon the reactivity of the particular kind of charcoal used.

Another form of adsorption occurs between a solid and a substance in solution. To show this, break off a half-inch of the lead of an indelible pencil and drop it into a bottle three-fourths filled with water. The dye contained in the pencil will form a solution of an intense violet color. Now pour out and discard the tinted solution. Rinse the bottle repeatedly with water un-



When sulphur is burned in oxygen, no change in volume of gas occurs in the tube, as shown by mercury in the U tube



Pour a little molten sulphur into a paper cone made from the corner of an envelope, as at right. Allow it to cool and observe crystals



with a Bunsen burner. The product of combustion would be magnesium oxide, which is a solid. Hence, if the test tube were closed and attached to a suitable form of manometer or pressure-recording device, the manometer would show a partial vacuum remaining in the tube after the magnesium burned, due to the disappearance of the oxygen. Under ideal conditions, not realizable in practice, the vacuum would be practically total.

A different situation arises if sulphur or charcoal is burned in oxygen. Here the products of combustion are sulphur dioxide and carbon dioxide, respectively, and both are gases and not solids. Hence at the end of this experiment, the total volume of gas in the test tube will not have changed at all.

You can prove this by burning some sulphur in a test tube of oxygen, coupled to a homemade manometer. Mount a test tube of hard glass horizontally, and sprinkle a thin layer of sand along its bottom to protect the tube from the heat of the flaming sulphur. Place a small amount of sulphur on top of the sand. Then fill the tube with oxygen gas, inserting the glass delivery tube all the way into the tube. The oxygen may be generated by heating potassium chlorate or in any other standard way. When the test tube is full, close it by attaching it to the manometer, which may consist simply of a U-shaped tube open at the end and filled with mercury.

Now heat the contents of the tube gently with a Bunsen burner. Soon the sulphur will catch fire and burn at the expense of the oxygen in the tube, forming sulphur dioxide. Because of the heat generated in the tube, the gaseous contents expand, and the mercury at first is driven up the far side of the manometer. As the apparatus cools, however, the mercury level returns toward its original position. At the conclusion of the experiment the mercury in each side of the manometer will again be at the same level, showing the same pressure within the test tube as at the outset. In other words, the volume of gas within the test tube remains constant; the oxygen has disappeared but has been replaced by an equal volume of sulphur dioxide gas.

Because mercury is rather expensive, it is not always available in a home laboratory. If no supply is at hand, however, another form of manometer can be constructed for (Continued on page 125)

Weird Fireworks From Hot Iron

SPECTACULAR fireworks are produced by an out-of-the-ordinary chemical experiment, using apparatus borrowed from the home workshop. Obtain a flat iron bar at least an eighth of an inch thick and half an inch wide, preferably a little larger. Heat one end red-hot or, if possible, white-hot. Then, with gloved hand or tongs, hold

the bar with the glowing end about half an inch above the surface of several drops of water placed on an anvil, and strike it with a hammer, forcing the hot iron suddenly down upon the water.

A loud report will occur, and sparks will fly about with beautiful scintillations like those produced by an oxyacetylene torch.

Examination of the bar will show that its end has virtually been torn to shreds. The experiment is harmless, provided no combustible material is within range of the falling sparks.

You may find a clue to the cause of the mysterious detonation if you recall a familiar laboratory experiment in which steam is passed over hot iron. The steam is decomposed and its oxygen unites with the iron to form black iron oxide, while hydrogen gas is liberated. This furnishes what seems to be a plausible explanation for the fireworks that occur in this demonstration. It is suggested that the sudden vaporization of the water to steam, its reaction with the iron, and the explosion of the hydrogen that is liberated, account for the report and the shower of sparkling globules of burning iron and the resultant, molten oxide.



The red-hot end of an iron bar, held above a few drops of water and struck sharply with a hammer, will produce a harmless explosion

Spun-Glass Filters Resist Corrosive Liquids

FILTERING corrosive liquids such as strong sulphuric acid offers a problem in the home laboratory, since these fluids attack ordinary filter paper. The problem may be solved by employing glass wool, or spun glass,

instead of paper. With a little practice it is easy to plug a glass funnel with a wad of just the proper compactness. If packed too tightly, it will stop the flow, while too loose a packing will not remove the particles to

be filtered out. Such a filter plug may be washed and used again. Glass wool suitable for the purpose is sold by dealers in chemicals and scientific supplies, and may be obtained at some stationery stores, since it is also used for decoration. It is best to handle the material with forceps or leather gloves, as the tiny filaments of glass may otherwise pierce the skin and remain there to cause several hours or days of discomfort.

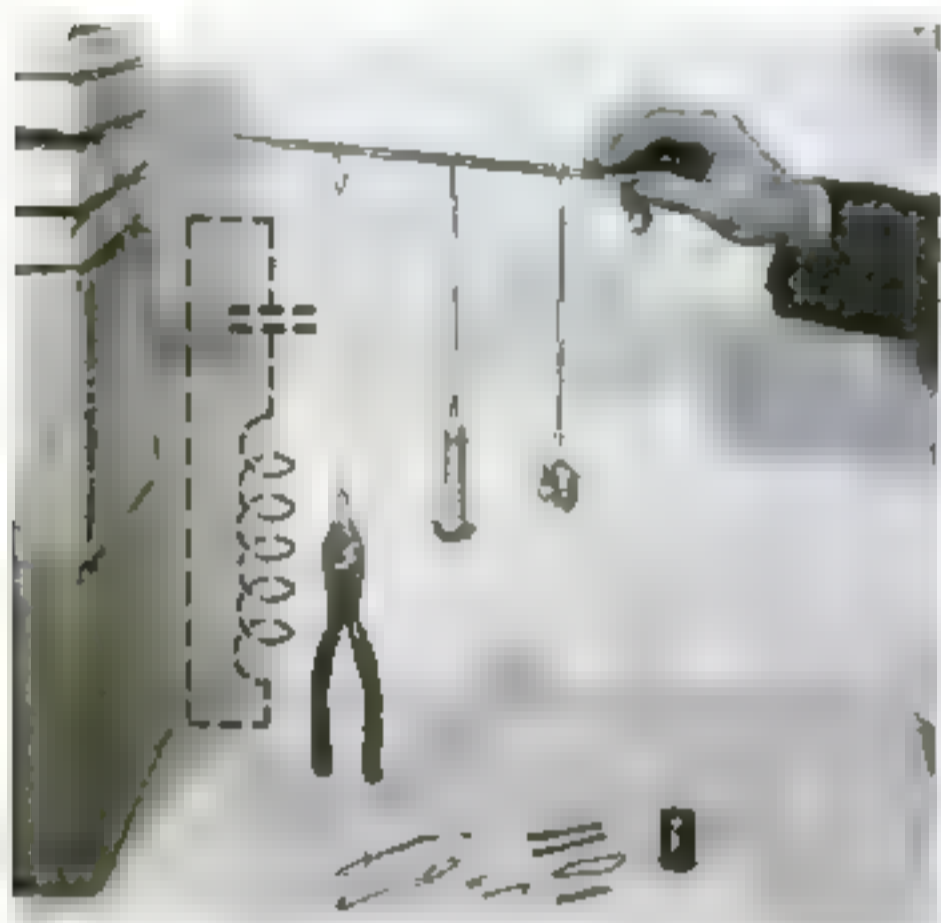


Spun glass being packed into funnel for filter

HOME TESTS OF Scientific Facts

Demonstrating Radio Tuning

WEIGHTS suspended from a flexible rod by rubber bands respond to vibrations of the rod according to their mass and the number of bands used. This shows how larger coils (weights) or condensers (rubber bands) in a radio circuit respond to lower frequencies.



Heavier weights, on more rubber bands, react to lower frequencies of vibration in the rod

Concave Mirror Makes a Reflecting Telescope

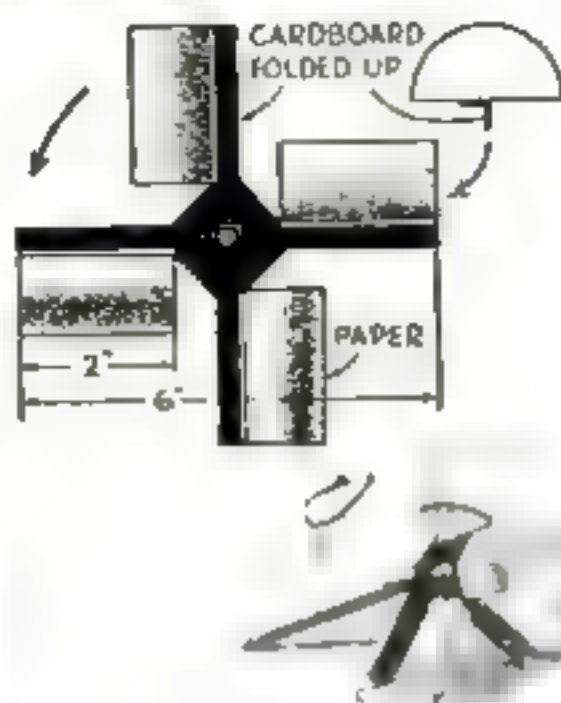
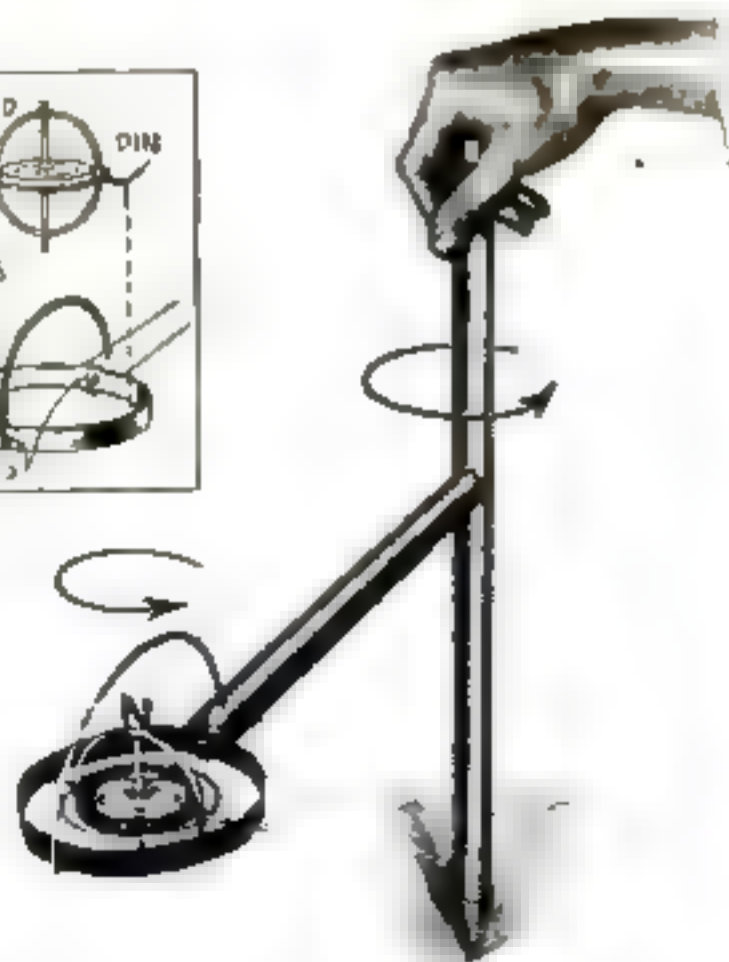
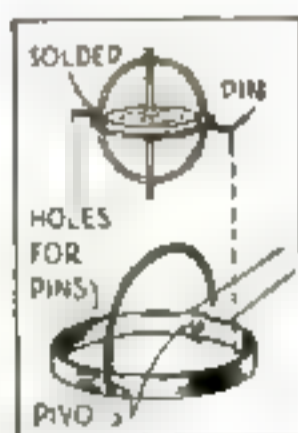
HOLD an ordinary concave mirror as illustrated below, and with a small magnifying lens at your eye you have the essential parts of a reflecting telescope like the huge instruments used by astronomers. The image you see will be inverted.



Image reflected by concave mirror is viewed through a lens

How a Gyroscopic Compass Works

THE principle of the gyroscopic compass can be demonstrated by means of the simple apparatus shown at the right. As the broomstick frame is rotated, the gyroscope top will adjust itself so that the spin of its wheel is in the same direction as the rotation, even if it has to turn itself completely over in order to do so. In a similar way, the rotation of the earth exerts a force on the spinning wheel of a gyroscopic compass, causing it to hold its axis in a north-and-south direction.



This Paradoxical Windmill Turns the "Wrong" Way

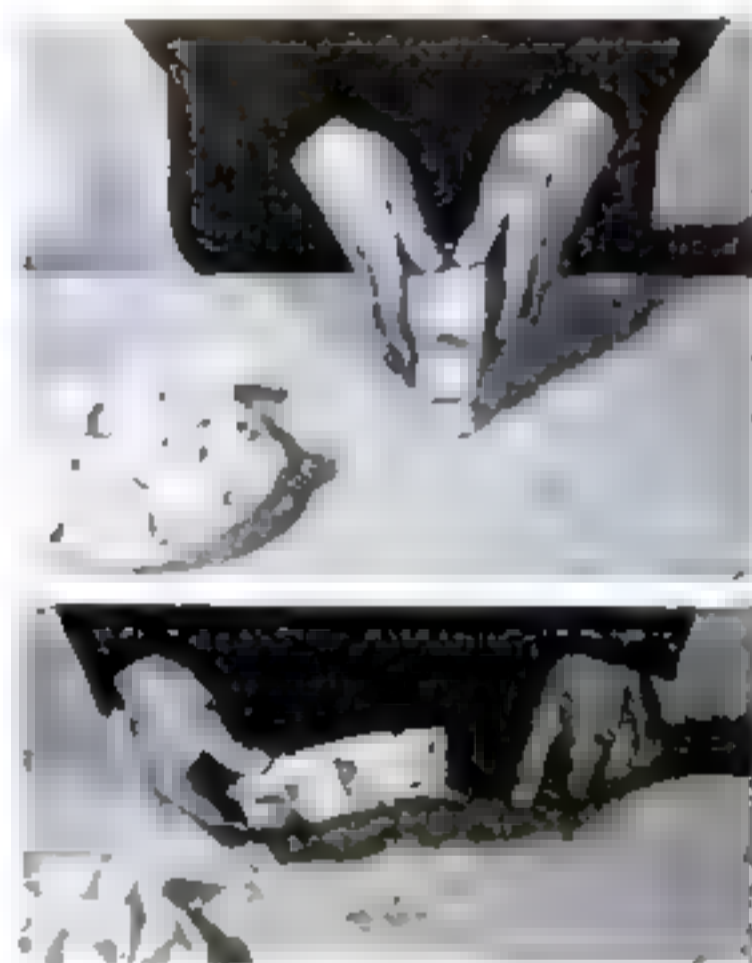
IF THE wind blows into the face of the windmill shown at the left, above, the wheel turns surprisingly in the counterclockwise direction, with the curved sides leading. The

reason is demonstrated by blowing air across the surface of a paper cylinder. As at the right, the cylinder is drawn toward the air because the curved surface lowers pressure.



Pressure Makes Ice Melt Faster

PRESSURE on a stack of ice cubes lowers the melting point so that they melt at adjacent edges without change of temperature. When the pressure is removed, the water freezes and holds the blocks together.



Ice cubes pressed together (top) freeze at edges when pressure is removed

Ripples Show the Laws Of Light and Sound

RIPPLES made in a pan of water by drops from a medicine dropper and observed by their shadows on white paper placed on the bottom of the pan, illustrate the properties of light and sound waves. Various shapes of tin as shown above may be used to demonstrate reflection and other action of light and sound waves.

Tubes and Angles Give Strength to Paper

A FLAT piece of paper is weak and flexible, but if rolled into a tube or folded, it acquires surprising strength. Strips that will not support their own weight become strong when folded into inverted V's. This idea is used in structural steel.

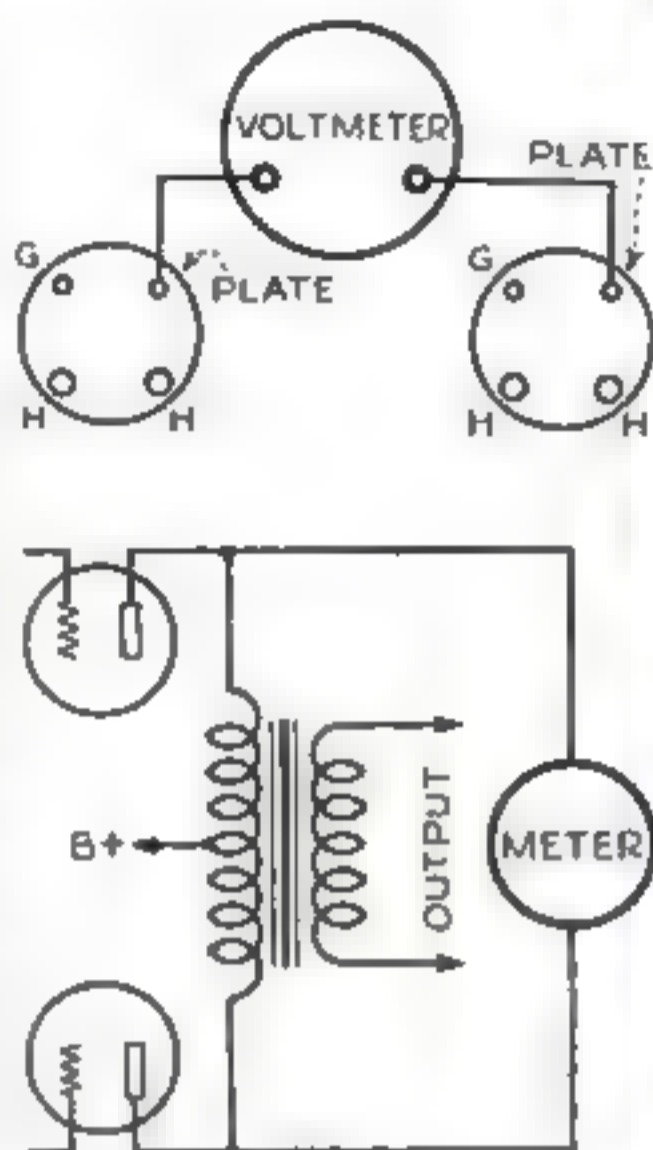


Tests show strength of paper when rolled into tubes or folded into V's

Suggestions for Radio Builders

Voltmeter Tests Push-Pull Tubes

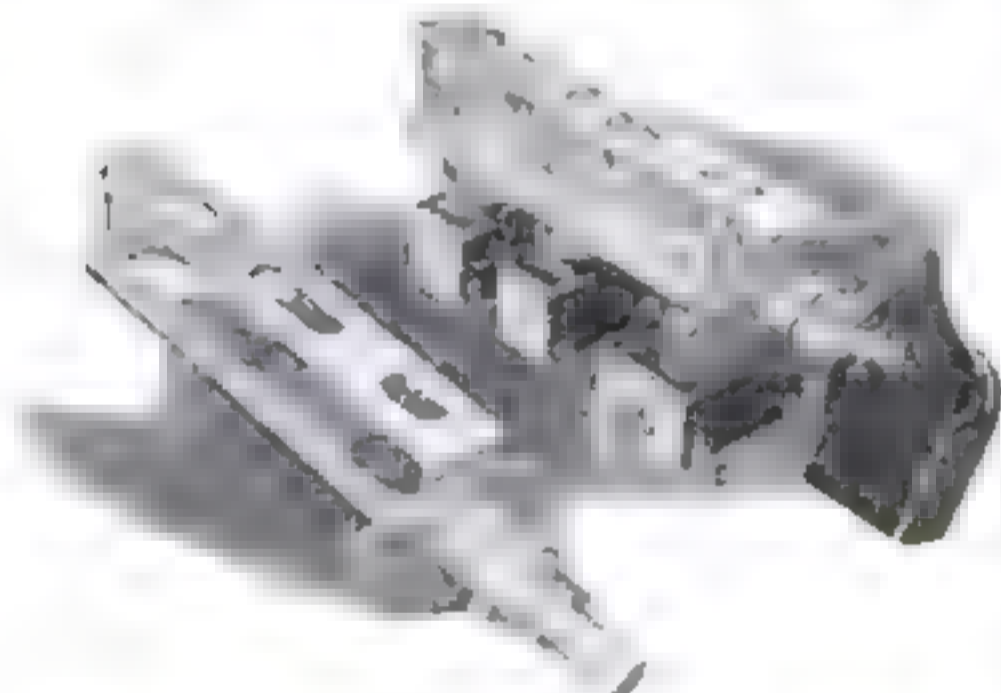
TO OBTAIN good quality from a push-pull amplifier stage, the two tubes must be matched. Although the usual practice is to test the set-up by placing a milliammeter in the plate circuit of each tube, the experimenter with limited equipment can obtain equally good results with a single low-range voltmeter. Connect the meter across the plates of the tubes by wiring connections to the proper prongs. A zero reading when the circuit is in operation indicates a perfect match. The higher the voltage reading, the poorer the match. The upper diagram at the right shows how the voltmeter is connected to the tube prongs; the circuit diagram shows how the connections to the prongs serve to insert the meter into the amplifier output. Use insulated wire for the connections, and make sure that the prong loops do not touch the metal chassis.



A low-range voltmeter connected across the plates of the tubes in a push-pull amplifier stage. This test shows whether the tubes match.

Novel Cradle Mounting "Gangs" Toggle Switches

TOGGLE switches can be "ganged" easily with a novel cradle mounting now available. As many as three switches can be mounted in the holder to provide complex switching arrangements at the turn of a single knob. By selecting the proper individual units, almost any combination can be worked out. In the picture below, two single-pole, single-throw units and a double-pole, double-throw unit are "ganged."



Cradle switch mounting alone and in sample set-up.

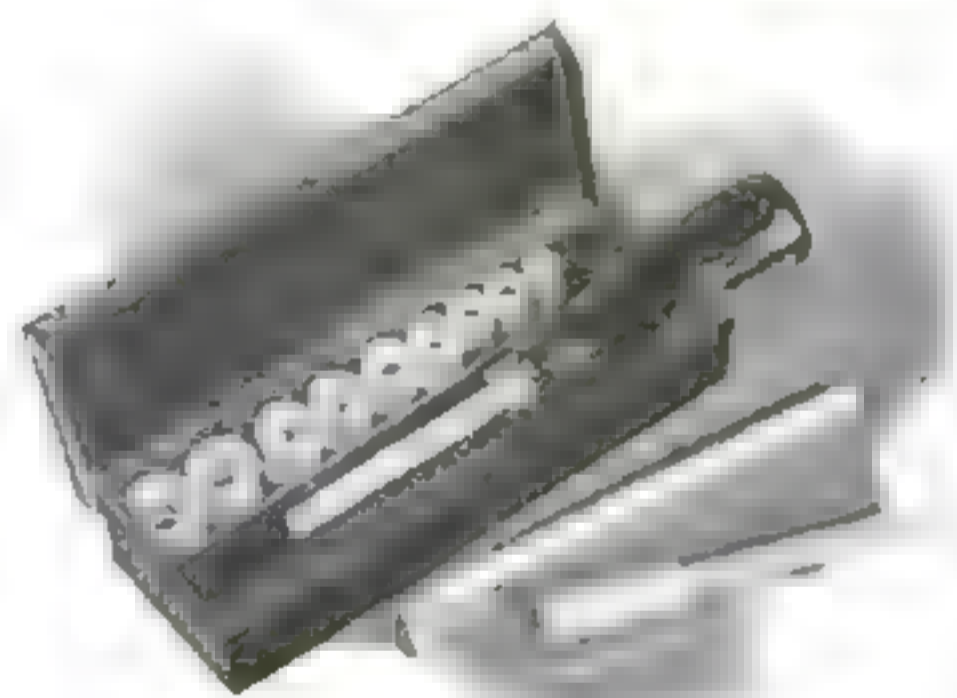


Hydrometer Parts Make Handy Portable Blower

BY COMBINING the bulb and tip of a battery hydrometer set you can provide yourself with a portable blower for removing dust from the "innards" of a radio set. Remove the two parts from the glass body of the hydrometer and force the end of the tip into the base of the bulb as shown. A squeeze of the bulb will force enough air from the tip to dislodge dust and dirt in out-of-the-way recesses of the chassis and cabinet.—F. W. BENTLEY, JR.

Socket-Wrench Set Has Cap for Knurled Nuts

BESIDES providing eight socket-wrench attachments designed to fit almost every type of nut used in radio work, the compact tool set shown below also contains a screw driver and a special cap for tightening knurled nuts. Housed in a metal case, the assortment comes complete with straight and L-shaped handle extensions.



Versatile socket-wrench set in its metal case.

Pocket Case for Tools

RESEMBLING a flat wallet, the roomy pocket tool case illustrated makes it easy to carry your radio tools with you. Constructed with two compartments, it will hold pliers, screw drivers, test prods, knife, and scale and can be stowed away in your hip pocket or fastened to your belt. It is a handy case for servicemen.



With this flat case, you can carry your tools in your pocket or on your belt.

Case Holds Small Cells in Series

TO SIMPLIFY the problem of connecting flash-light cells in series for use in portable receivers, a manufacturer recently devised the compact cell case shown. No soldering is necessary; the two cells are simply slipped into the holder, a spring clip at one end of the case insuring good contact between the cells. A switch mounted on top of the case



provides a convenient means of controlling the three-volt supply. The holder can be mounted easily in one corner of the average portable cabinet.

Novel Condenser Tester

MEASURES RADIO CAPACITIES



By
J. B. CARTER

HOW often have you wished you knew the capacity of some unmarked condenser? How often have you wondered whether a certain condenser was good or bad? The inexpensive and easily built capacity analyzer illustrated will provide answers to both questions—easily and quickly. With it, you can not only test condensers for open circuits, leaks, and shorts, but you can measure their capacity down to the last fraction of a microfarad.

The circuit, based on the well-known bridge hook-up, is simplicity itself. A rectifier tube, a few fixed condensers, a potentiometer, a voltage divider, and a few other odds and ends are all the parts required.

In use, an alternating-current voltage is balanced across a good condenser of known capacity and is made to assume the same value across the unknown condenser being tested. This is accomplished by adjusting a variable 10,000-ohm, wire-wound potentiometer until there is no sound in a pair of headphones connected to the circuit. Then, by calibrating this potentiometer to obtain a divided dial it is possible to read the capacity of the unknown unit directly from the scale.

A typical calibrated scale is shown full size in the accompanying diagram. The calibration or divisions indicated, of course, apply only to the make of potentiometer used in the original circuit. For other makes, the calibration will have to be made by testing condensers of known value.

For purposes of illustration, however, let us suppose that the circuit is constructed exactly as shown, using identical parts. The

first step then will be to set the pointer on the potentiometer so that the readings on the scale shown will be correct. To do this, plug an earphone set into the phone terminals and obtain a good-quality condenser whose capacity is known. A .5-mfd. unit will serve nicely. Then, set the selector switch (S_1) to the range (4) which includes all capacities from .1 to 5 mfd. and attach the .5-mfd. condenser to the test terminals (marked X in the diagram). Next turn the potentiometer shaft until no noise is heard in the earphones, and finally slip the pointer onto the shaft and fasten it in place so that it indicates exactly .5 mfd. on the divisions of the scale. Once the pointer is in place at the correct point, the scale is calibrated for all other values.

If a different make of wire-wound potentiometer is used, fasten a piece of paper under the potentiometer knob. The paper should be blank except for the four concentric arcs to indicate the four scale ranges. When nine high-grade condensers having capacities of .01, .02, .03, .04, .05, .06, .07, .08, and .09 mfd. have been obtained,

connect the .05-mfd. unit to the test terminals, set the selector switch to the proper range (3), adjust the potentiometer shaft until the hum in the earphones disappears, and fasten the potentiometer pointer to the shaft so that it points approximately to the center of the scale. Then draw a line out on a diametric line so that it crosses all four concentric arcs. This will give you the .05-mfd. point on the third scale, the .5-mfd. mark on the second scale, the .5-mfd. mark on the inner scale, and the .005-mfd. mark on the outer scale. Likewise, by shifting the range selector to the No. 5 position and retesting, the .05, .5, 5, and 50-mfd. calibrations can be obtained.

The process should then be repeated with each of the other known condensers, doubling up whenever possible and taking care to see that the selector switch is set to the proper capacity range in each case. The various ranges available are indicated in the accompanying table. When all the tests are completed, you have a dial with four scales, each scale having thirteen divisions to give a total range of from .001 to 50 mfd.

To measure the capacity of an unknown paper or mica condenser, practically the same procedure is followed. Insert the condenser leads into the test terminals and select an approximate scale by setting the selector switch to some value that seems appropriate. This first setting is entirely a guess. Then rotate the knob. If the hum in the earphones does not disappear at some point, select another capacity range and rotate the potentiometer again. When the scale is found that causes the hum to disappear at some point on the potentiometer dial, turn the knob slowly to obtain the accurate position. The reading



Close-up of tester to show panel layout. The calibrated dial for the potentiometer is reproduced full size on the opposite page

Easily Built Analyzer Makes It A Simple Matter To Determine the Values of Unmarked Condensers Or To Test for Leaks and Shorts

of the dial at that particular point will be the capacity of the condenser in microfarads. Of course, the reading must be made on the one of the four scales that corresponds with the setting of the selector switch.

While the above test can be used for paper and mica condensers, it is necessary to apply a polarizing (direct-current) voltage when testing condensers of the electrolytic type. To do this, first close switch S_3 . This completes the filament circuit to the type '80 tube and places the rectifier circuit in operation to provide direct current instead of alternating current at the test terminals. Then set the voltage-range selector switch S_2 to the No. 2 position to provide approximately 100 volts and attach the unknown condenser to the test terminals, paying particular attention to the polarity of the leads. Reverse polarity is likely to damage the condenser if left too long. The remainder of the test then is the same as that used to test condensers of the paper or mica variety.

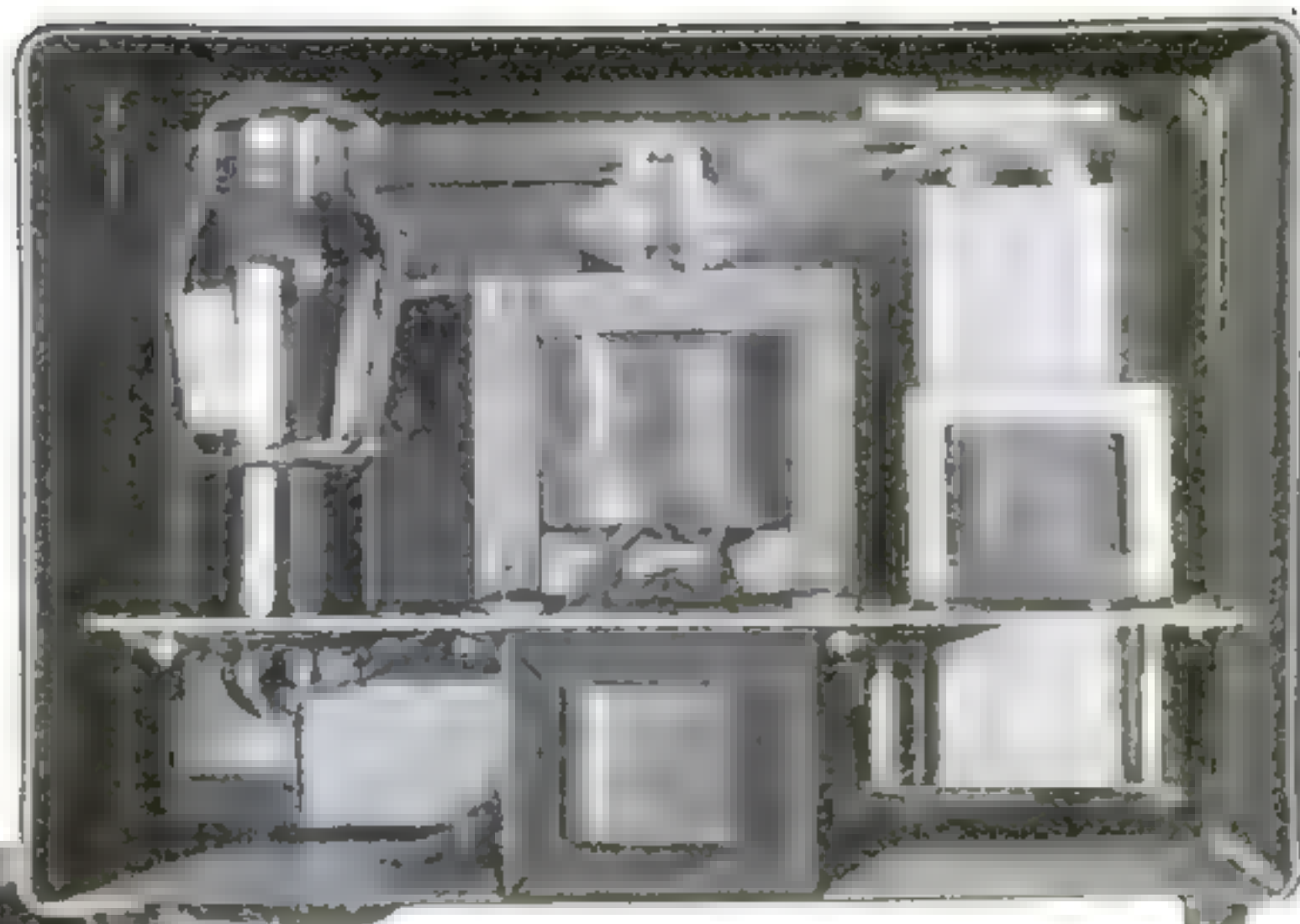
To test for leakage, it is important that the test be made at the exact working voltage of the condenser. Many condensers do not leak at low voltages but do at their rated voltages.

The leakage test is performed as follows: Since direct current is desired, set switch S_3 to the "on" position. Then adjust the switch S_1 to its No. 1 position and rotate switch S_2 to the rated voltage of the condenser.

Finally, with the condenser attached to the test terminals, watch the neon bulb. A good condenser will light the bulb momentarily, due to the condenser taking the initial charge, but the lamp will go out almost immediately and stay out.

If the light blinks, the condenser is leaky and in all probability is useless for radio work, especially at the rated voltage. If the neon bulb glows continuously, the capacitor is completely shorted and should

Below, testing a condenser to determine the cause of failure. The glowing neon light shows that the unit under test is completely shorted



Rear view of the cabinet with back removed to show how parts are placed on the chassis

LIST OF PARTS

- T.—Power transformer, 50-volt tap.
- S_1 and S_2 .—Selector switches, rotary, five contacts.
- S_3 .—Toggle switch (on-off).
- S_4 .—Switch on potentiometer R_1 .
- R_1 .—Potentiometer, wire-wound, 10,000 ohm, 50 watt, with switch.
- R_2 .—Voltage divider, 30,000 ohm, 50 watt, with five connection clips.
- Ch.—Chokes.
- Condensers.—Two 8-mfd. electrolytic condensers. Five high-grade paper condensers (600-volt rating)—one .005 mfd., one .05 mfd., two .5 mfd., and one 5 mfd.
- Miscellaneous.—Metal cabinet, aluminum chassis, one $\frac{1}{4}$ -watt neon bulb and socket, two phone-tip terminals, dials, etc.

be discarded. An open circuit in the condenser will be shown by the fact that the lamp will not light at all; even the momentary glow will be missing.

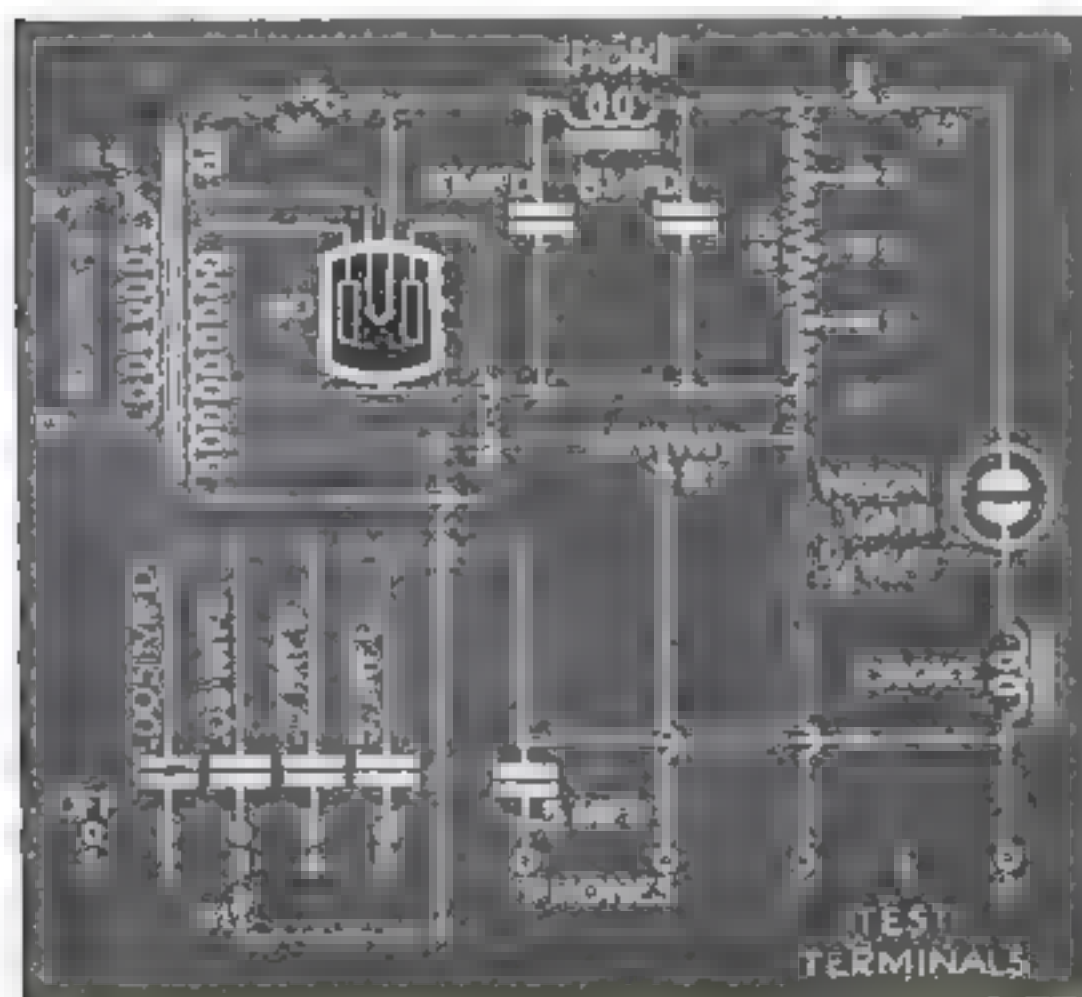
Since the main power switch (S_4) is built into the potentiometer (R_1), the entire circuit will be dead when the potentiometer is rotated as far as possible to the left. This must be taken into consideration when making tests.

When carefully constructed, this tester will make it easy to locate hums and crackles in ailing circuits, since it has been estimated that over forty percent of the common noises in receivers are caused by capacitor failures. Unlike most testers, it subjects the condenser to actual working conditions to show up faults that would remain hidden under ordinary tests.

The hook-up is straight-forward, and the placing of parts can easily be seen in the photographs. The important part of the construction is the selection of parts. The condensers and potentiometer must be high-grade units. Likewise, if condensers are used to calibrate the dial, they must be reliable.

Aside from its use as a tester, this circuit, incidentally, can be used as a variable "B" supply since the direct current available at the test terminals when the rectifier circuit is in operation is practically noiseless and hum-free. The voltage is sufficient to power a three or four-tube receiver.

Based on a simple bridge hook-up, the circuit is simplicity itself, as shown by the diagram below

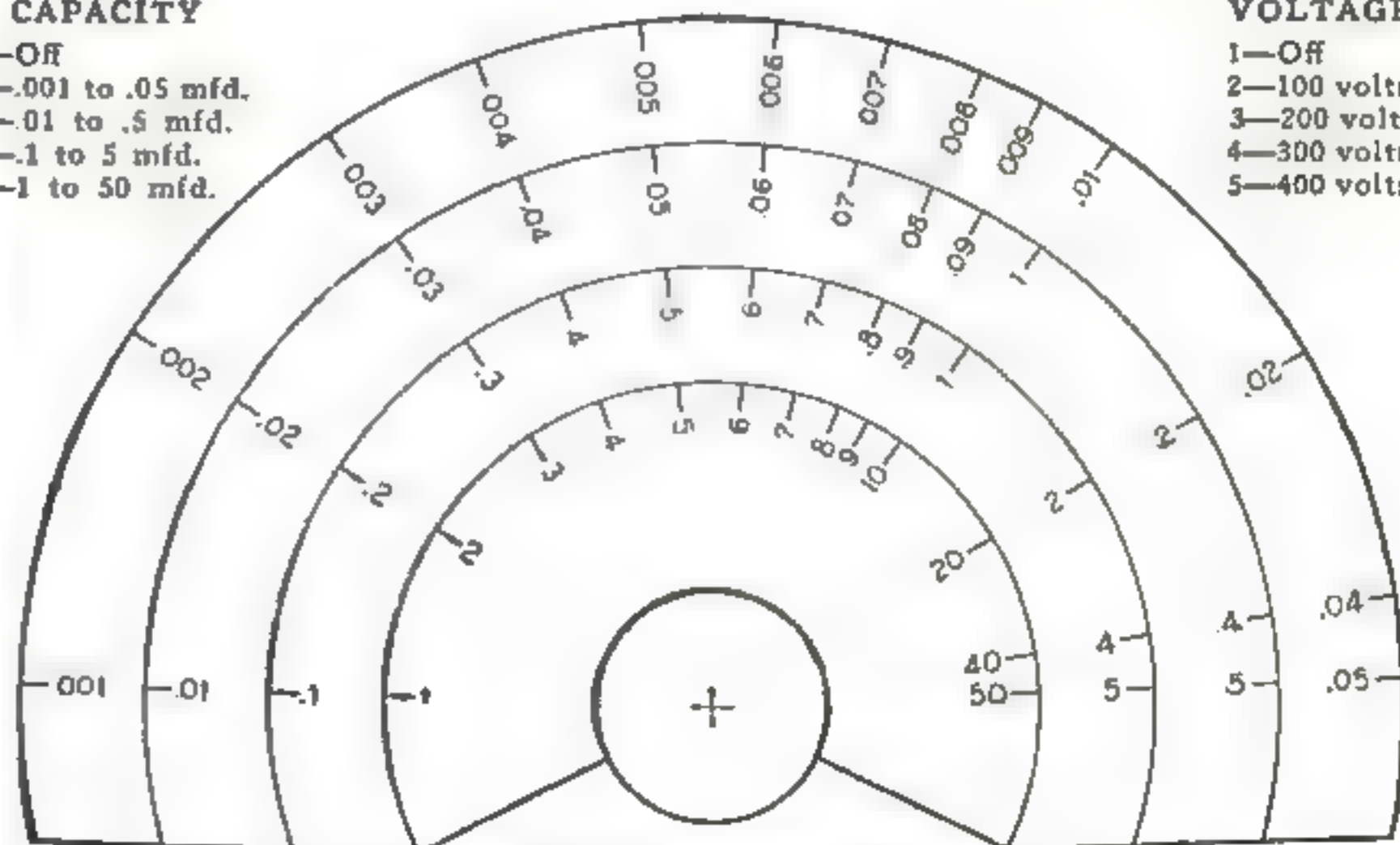


CAPACITY

- 1—OFF
- 2—.001 to .05 mfd.
- 3—.01 to .5 mfd.
- 4—.1 to 5 mfd.
- 5—1 to 50 mfd.

VOLTAGE

- 1—OFF
- 2—100 volts
- 3—200 volts
- 4—300 volts
- 5—400 volts



Full-size drawing of calibrated dial. Tables indicate ranges on the selector switches



"I'll be glad to give you a lift, Gus," said Sisson, while the gas was being transferred. "Maybe you can spot a squeak I'm hearing."

GUS gives some pointers on . . .

Hunting Squeaks and Rattles

By MARTIN BUNN

GUS WILSON'S huge fists spun the steering wheel and the Model Garage service car, homeward bound, swung around in the loose sand at the foot of Steppe's Hill and started the long grind to the top.

"What makes these birds always break down in such out-of-the-way places?" Gus grumbled. "They might at least pick some place better than these deserted hills!" Joe Clark, his partner in the operation of the Model Garage, merely grunted and pulled his cap lower over his grease-stained face.

"The next call we get from out here," Gus rumbled on, "I'm going to—" The rest of his remark was drowned in a rasping cough from the service-car motor, followed by a bucking that ended in a stall.

Gus slammed on the emergency brake and leaned back with a grin on his face as he pulled out his pipe and started to fill it.

"Well? What's the matter now?" snapped Joe. "Dinner is waiting and I'm hungry. Let's get at the trouble."

"There's nothing to get at," Gus chuckled. "We're just out of gas! I forgot to take a look before we started out. Nearest gas station is about three miles down the road. If you want to 'get at' something, try bending a bit of shoe leather in that direction. Danged if I will. I'd rather wait here for a car. Jack Sisson goes by here every day on his way home from work. He ought to be along any minute now."

"That's like you, Gus," Joe smiled, sheepishly. "Taking the blame when you know it's my job to see that this bus has

gas in it. All right, if Jack doesn't show up in the next five minutes I'll start."

However, Joe was saved the trouble, for Sisson came along a few minutes later.

"Now," said Gus after the gas had been transferred, "Joe, you take the service car and beat it straight home before your missus gets out the rolling pin. Jack'll give me a lift as far as the garage."

"Glad to do that, Gus," Sisson offered at once. "And maybe you can spot which valve stem is making the infernal squeak I've been hearing."

Gus listened intently as Sisson started the car and drove it at various speeds. No noise was apparent at high speed, but when the car was running slowly, there was a pronounced squeak that seemed to keep time with the revolutions of the motor.

"It's going to be a cinch to fix that," Gus grunted, as they pulled in at the Model Garage. He lifted the hood, wiped a bit of grease from the steering-gear housing and touched it to the V surfaces of the fan belt. The squeak stopped almost instantly.

"A brand-new, bone-dry belt will sometimes do that," Gus explained. "It depends on the condition of the pulley surfaces."

"Gosh!" exclaimed Sisson. "As easy as that, eh! I wish it was as simple to spot the cause of other noises. You know, I'm a bug on trying to get rid of 'em."

"Lots of fellows are like that, these days," Gus agreed. "If you want to get rid of noises in your car, the main things you need are a whale of a lot of patience

and a nice long screw driver."

Sisson laughed. "Sure, you need patience—but what's the screw driver for? To tighten everything so it can't squeak?"

"There'll be times when you'll use it that way, but the principal use will be as a sort of doctor's stethoscope to help you locate just where the noises are coming from. Trouble is, so many noises sound like they are something else. Like this squeaking belt. You thought it was a valve stem binding. If you had held the end of the screw driver against the cylinder casting at different points near the valves, with the handle end cupped in your fist against your ear, you'd not have heard the squeak at all—which would have been pretty good proof that it wasn't a valve."

"Take a loose plate in the muffler," Gus went on. "That often rattles in such a way that it sounds just like a loose connecting rod. If you listened around with a screw driver a while, you'd hardly hear any trace of a clank from any part of the motor, but as soon as you started on the exhaust pipe you'd hear it—and I don't mean maybe!"

"I've heard of that screw-driver stunt," Sisson observed, "but I never could make much out of it. I've tried it several times, and all I hear is a jumble of noises loud enough to break your eardrum."

"That's because you don't hold the screw driver right," Gus asserted. "When you poke the end of a screw driver against any metal or wood part of the car, the vibrations that are traveling through the material shoot *(Continued on page 126)*

THE HOME WORKSHOP

Craftwork with TIN CANS

... A fascinating new hobby that costs next to nothing for materials

By EDWIN T. HAMILTON

ABOUT three years ago I learned of a number of schools, social centers, clubs, and individuals interested in art metalcraft who had had to abandon their hobby because of the initial cost of the required metals. They had the necessary tools, but could not afford to use them. Gold and silver, and even copper, brass, and pewter, were altogether too expensive for depression days.

In an effort to meet this situation, experiments were started with tin cans. Up to that time, discarded cans had been put to many useful purposes, but had never made their appearance in the field of art craftwork. If methods could be found by which this metal could be properly worked, it seemed to be the obvious answer to the problem.

The advantages of such a metal are numerous. It is free. The supply is inexhaustible. It can be obtained easily and quickly in practically any locality in the country. But when actual work was started, experimentation soon proved it has quite as many disadvantages, and these had to be mastered before success could be claimed.

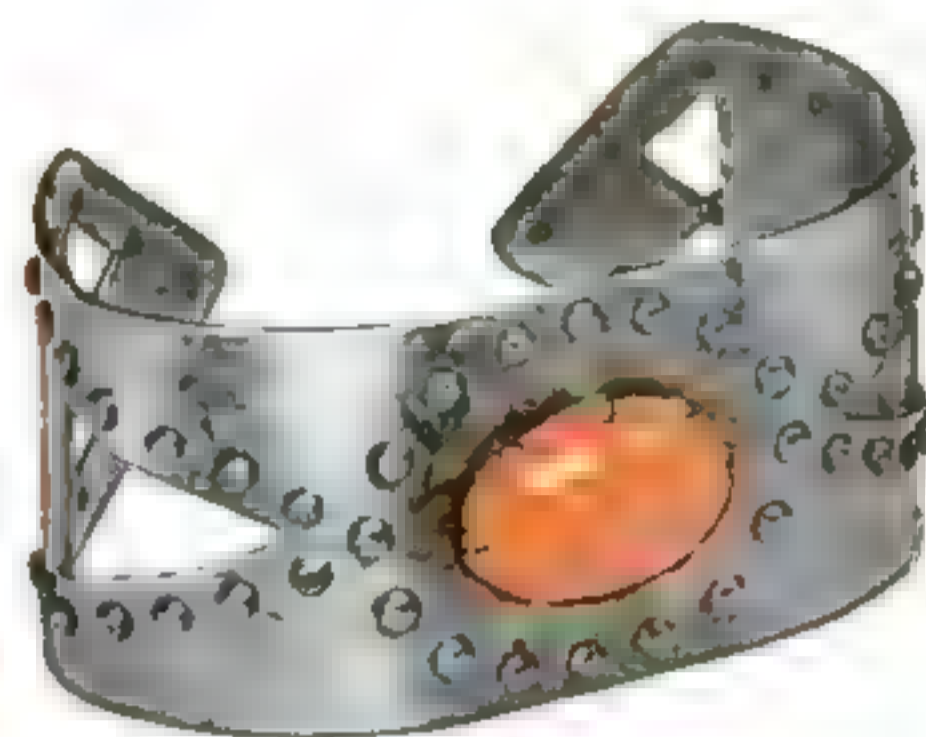
The very composition of the metal proved the first difficulty. The tin plate

of which tin cans are made consists of a thin sheet of soft steel coated on both sides with pure tin. In fact, about ninety-eight percent of this so-called "tin can" is mild steel with a deposit of about two percent of tin distributed equally on both sides.

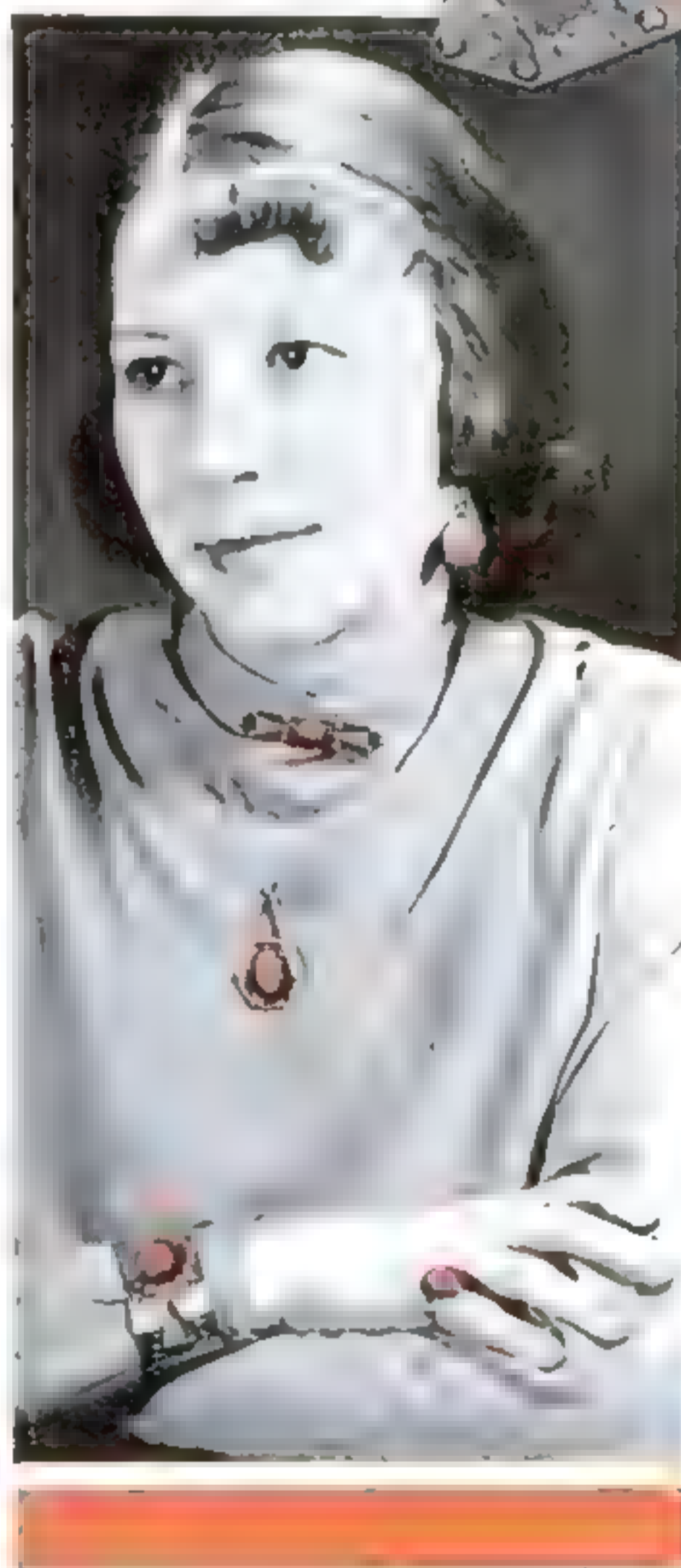
While the finer metals, such as gold, silver, copper, and brass, present the worker with a solid mass, tin plate gives him three layers of two extremely different metals with which to work. One of these is hard, and the other is unusually soft. The difficulties of working such a combination as a single metal are obvious. One melts at a different temperature from the other. One can be cut with the finger nail, while the other requires the tough teeth of a metal saw.

Aside from these difficulties brought about by the composition of the metal, means had to be found to overcome its extreme thinness. How could a metal as thin as tin plate be drawn? How could it be sawed without buckling? How could the proper thickness be obtained for trays, paper knives, belt buckles, book ends, and similar objects requiring strength and depth? All of these problems had to be solved. But that was three years ago!

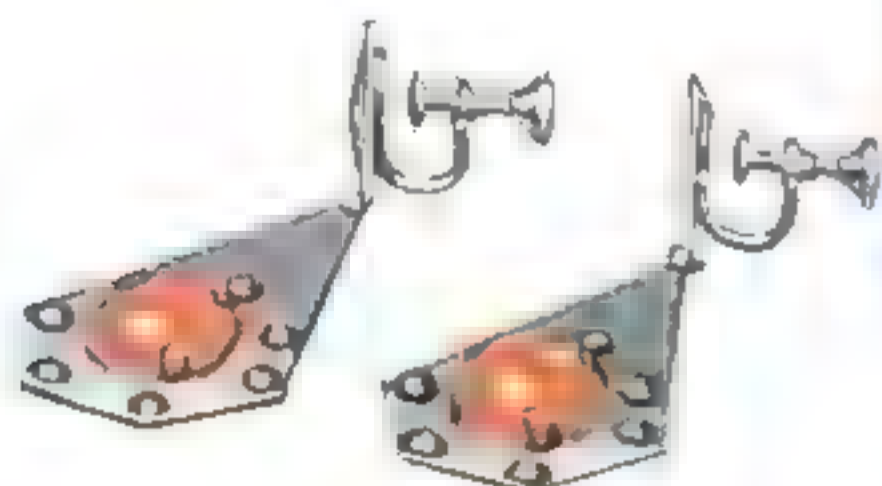
Today, practically every known operation done in the finer metals can be accomplished in tin plate. In many cases the procedure is different, but the results are the same. That is the important thing. We are interested in results far more than we are in how those results are obtained. We know the best way of sawing, planishing, riveting, scribing, drilling, shaping, drawing, plating, chasing, engraving, soldering, and enameling tin plate. It is true that some of them are more difficult than the same operations in the finer metals; but



The bracelet shown above is the piece described in detail because it involves practically all the chief processes in tin-can work



This unusually distinctive costume jewelry is made from tin-can metal left in natural finish



Here are close-up views of the earrings, pendant, and ring. When thick metal is required, as for the pendant, a number of pieces of tin are soldered together

THIS ARTICLE TELLS YOU STEP BY STEP HOW TO MAKE A FINE BRACELET . . . YOU CAN USE THE SAME METHODS FOR MANY EQUALLY BEAUTIFUL PROJECTS



Small inside areas are removed by using a sharp cold chisel, held vertically. Rest the tin on a wood, lead, or steel block. Have the chisel so sharp that a single blow will cut through

To planish tin plate, set it on a lead or hardwood block and use the round end of a machinist's ball-peen hammer. Deliver each blow squarely from the elbow

original projects. (See the list below.)

Prepare a full-size pattern of the stretch-out shown in the graph plan on squares representing $\frac{1}{4}$ in. each. Obtain a fruit, coffee, or evaporated milk can large enough to provide two pieces of tin plate $1\frac{1}{2}$ in. wide and $6\frac{1}{4}$ in. long. Cut off the top and the bottom of the can just under its seams with an ordinary can opener. With shears, cut up the can on both sides of its side seam and discard this soldered portion. Stretch the tin out. This can be done with a wood mallet, or the tin plate can be pressed flat by drawing it over the edge of the bench.



Cut out two pieces $1\frac{1}{4}$ in. wide and 6 in. long with the shears. Place the pattern on each of these pieces and use carbon paper to transfer the end points. Cut these with the shears. Place one piece on top of the other and test to see that they are duplicates. Place them in the vise and file all cut edges smooth and round. This can best be done with the aid of an ordinary flat file.

The pattern is again placed in position and the open areas of the bracelet traced on the tin. These are shown by tinted areas in the graph plan. Chisel these out as shown in the photograph of the chiseling operation.* When one piece has been completed, its duplicate must be planished before being chiseled.

Great care must be taken when planishing tin plate. The extreme thinness of the metal will not permit deep planishing. Place the piece on a lead or hardwood block. Starting at one end, tap the entire surface with the ball peen or round end of the hammer. Do this with light taps, as shown in the planishing photograph. Do not strike the surface heavily enough to flare or curl the metal.

Place the chiseled piece, which was completed before, on the planished one and trace with a scribe the outlines of the chiseled triangles. If a scribe is not available, use the point of an ice pick. Here again great pains must be taken. As the pure tin coating is extremely soft, all scribing must be done with the lightest touch possible so as not to pierce the tin

* This photograph and the four hereafter mentioned are from "Tin-Can-Craft" by Edwin T. Hamilton, copyright 1935, and are used by permission of Dodd, Mead & Company, Inc.

if one wishes to work with a free metal, he should be willing to make certain sacrifices.

During experimentation, one great advantage became evident. Here was a craft any one could afford. The trial-and-error method of learning most crafts is an expensive one at best, but in this one it can be pursued without thought of its cost. We also found that the average amateur would attempt operations in tin plate that he would never dream of trying on a good metal. While an error in sawing a sheet of silver or gold might ruin the piece and prove extremely costly, a mistake in tin-plate sawing costs only the work of opening another old can.

Practically every type of object made in other metals has been executed in tin plate. Such things as desk sets, trays, book ends, dishes, candlesticks, boxes, lanterns, and every type of jewelry have been fashioned from it. The finished objects can be left in their natural state or they may be plated in gold, silver, copper, brass, or even platinum.

The set of costume jewelry shown in the illustrations on page 57 is in its natural state. Planishing tin plate—that is, hammering it lightly—brings it the appearance of old but highly polished pewter, with the fascinating gleam of light and dark areas usually associated with old wrought iron. I have called this new type of work "tin-can-craft." Let me introduce it to you through step-by-step instructions for completing one piece of jewelry. The bracelet illustrated at the beginning of the article has been chosen for this purpose because it requires a number of different operations. Once the method of carrying out the various processes has been mastered, it is possible to make a great variety of

WHAT YOU SHOULD KNOW ABOUT Tin-Can Craftwork

Projects. Fruit, coffee, or evaporated milk can large enough to provide two pieces of tin plate $1\frac{1}{2}$ in. wide and $6\frac{1}{4}$ in. long. Cut off the top and the bottom of the can just under its seams with an ordinary can opener. With shears, cut up the can on both sides of its side seam and discard this soldered portion. Stretch the tin out. This can be done with a wood mallet, or the tin plate can be pressed flat by drawing it over the edge of the bench.

boxes, cuff links, door stop, earrings, escutcheons, flower bowls and vases, flowerpots, fruit bowl, garden lantern, hanging lamp, etc.

pen and pencil trays, pendants, picture frames, pin trays, place-card holders, etc.

etc.

ing, drawing, riveting, soldering, planishing, chasing, en-

graving, plating, enameling.

Finishes. Natural, polished, anished, or plated with silver, gold, or other metals.

Tools. For making the bracelet described: Can opener, lightweight mallet, cutting shears, or tin snips, etc.

etc.

clamps, flat file, set of needle files, gas blowpipe or alcohol mouth blowtorch, two asbestos soldering blocks, a lead or hardwood block, and a vise. Few projects are as elaborate or require more tools, but other tools such as used for ordinary decorative metal work may be added as required.

etc.

as required.

through to the steel core. Any mistake in scribing cannot be erased, so do this work carefully. The six triangles in this piece are then cut out. Do this chiseling on the planished side, which will leave any resulting burrs on its underside. Go over all edges of the triangles with a needle file until perfectly smooth.

The pieces are now soldered together by the familiar process known as "sweat soldering." All soldering of tin plate is done with soft solder. Scrub one face of the unplanished piece with emery until it shines brilliantly. Place it on an asbestos block with the clean side up. Do not touch the surface with the fingers after it has once been cleaned. The entire surface is now covered with a flux. The so-called "killed acid" flux is recommended. This is ordinary commercial muriatic acid in which scrap zinc has been dissolved until the acid will take up no more. If the flux does not run smoothly over the surface, it is an indication that the tin has not been properly cleaned. This surface is now "tinned," which simply means that it is entirely covered with solder, spread as smoothly and thinly as possible. My preference is to use a gas blowpipe, but if gas is not available, an alcohol mouth blowtorch may be used. After applying the solder, go over it with the heat to make it as smooth as possible.

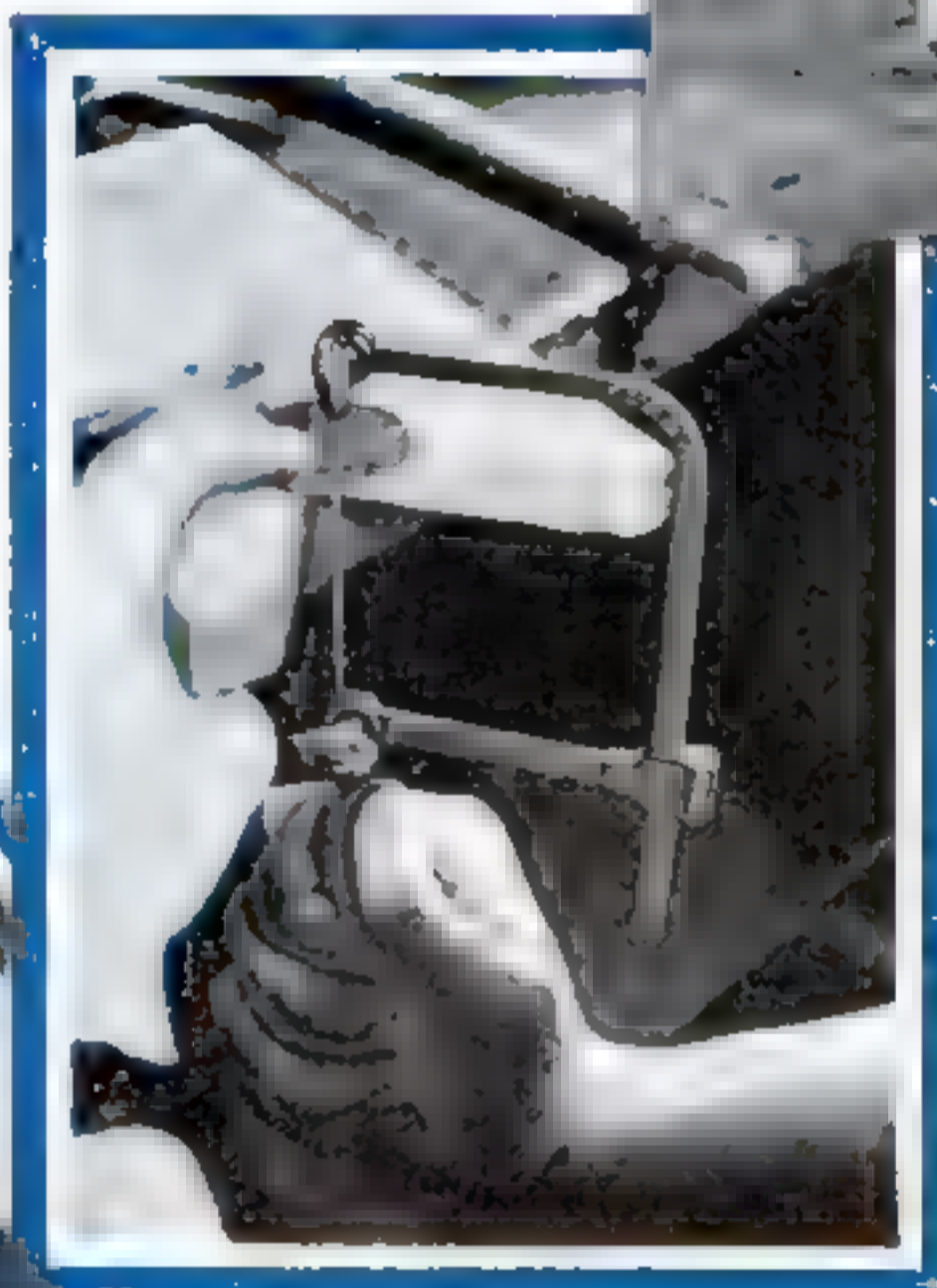
Allow the solder a minute to cool and then scrub the underside of the planished piece until clean. Place it, planished side down, on the asbestos pad. Cover its surface with the flux and then place the tinned side of the first piece in position on

wish, the upper piece may be held with spread tongs in position on the under one, but this requires considerable skill. When clamping the pieces together, allow one end or side to protrude slightly from under the pad, as illustrated. Heat is now applied to the exposed edge. When the solder shows signs of running, remove the heat, allow the metal to cool, unclamp and change the position of the work, and then again apply the heat to a new part. Continue in this way until all parts have been soldered together.

The work is now removed from the clamps and the entire piece washed to remove all traces of the acid. Hold



Since the bracelet is double thick, the two pieces are "tinned" with solder on one side, clamped together between asbestos blocks, and heated until the solder "sweats" them



When sawing is necessary, the tin is supported on a V-block and a jeweler's saw is used. At left: Needle files serve for cutting out and finishing irregular shapes, such as gem settings



the fluxed piece, the tinned surface, of course, being turned down. A second asbestos pad is now laid in position on top of this assembly and the entire assembly held tightly together with two bench clamps or common C-clamps, as shown in the photograph of sweat soldering. If you

it under hot water and use a small nail brush around its edges. Dry the piece thoroughly. It is then clamped in the vise and all cut edges smoothed and rounded with needle files. Go over all outer edges with a flat hand file. Smooth and round them with emery.

From the pattern, trace the rivet locations on the piece. Brass rivets of 1/16-in. diameter are recommended. Drill all rivet holes and set the rivets. Flatten them

out on the underside of the piece and then smooth them with a file and emery cloth. At this time the bracelet is given its shape over a bracelet mandrel, if available, or a broom handle. Place the end of the piece against the mandrel, tap it with a wood mallet, move it forward, tap again, and proceed in this manner.

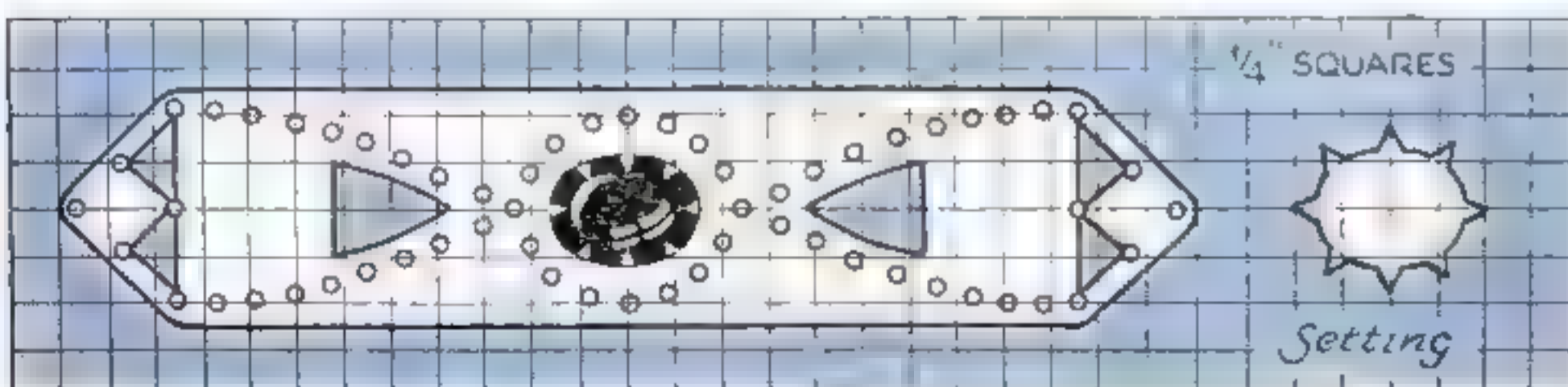
The setting of the stone is the last operation. Semiprecious stones of all sizes and shapes can be bought at jewelry or art metalcraft stores. Very attractive ones can often be found in cheap jewelry at the five-and-ten-cent store. These can be removed from their settings and used in your own articles.

When the stone has been obtained, place it flat on a piece of tin plate and run a scribe lightly around its base. Enlarge this oval 1/4 in. all around and saw it out. Tin plate is sawed on a V-block as in the photograph at the left above.

The small prongs are then laid out on this piece. The outline is marked "setting" on the graph plan. Place this piece in the vise and file out the prongs with a needle file. Note this operation in one of the photographs. Bend each prong up slightly and shape the mount to fit the top curve of the bracelet, which should be almost flat. Sweat solder the setting in place in the manner already explained. In this job, however, the setting is held with tongs. Clean the entire bracelet with emery and any good metal polish.

Place the stone in the center of the setting and bend the prongs over it. Do not tap these in place, but press them around the stone with a wooden stick.

If you would like more articles on tin-can craftwork to be prepared for publication in future issues, please send a post card to the Home Workshop Department.



This is the pattern or stretch-out for the bracelet and the extra piece that is soldered in the center of the bracelet to hold the stone. The rivets, which are of brass, are added for decorative purposes



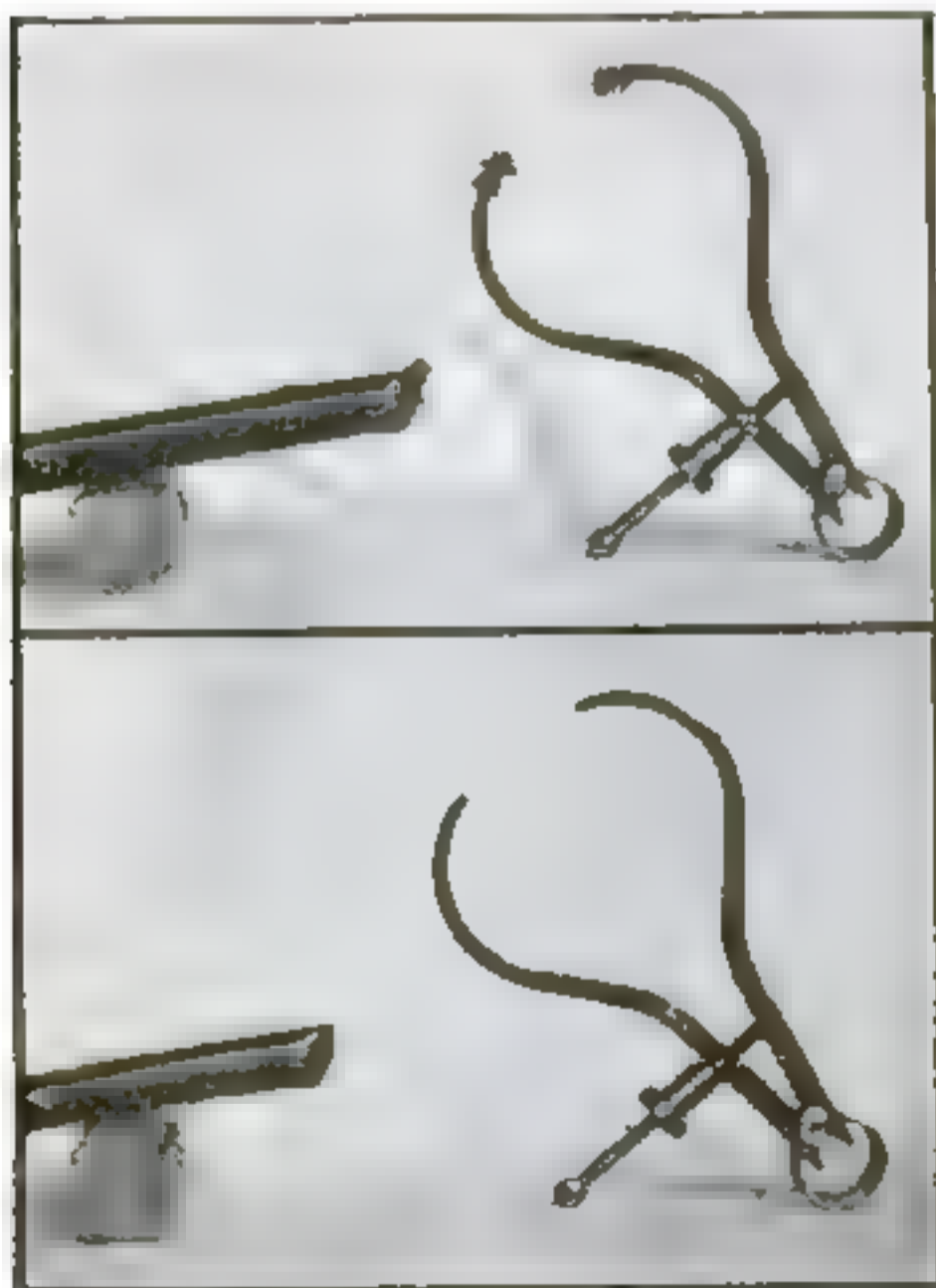
HOW TO DEMAGNETIZE TOOLS AND WATCHES

BEFORE building the demagnetizer illustrated above, we were constantly bothered with magnetized lathe tools, drills, reamers, and other tools. These would hold the chips, often causing the tool to jump and mutilate the work.

The materials required are 4 lb. No. 26 enameled magnet wire costing approximately \$1.20; two 2-oz. rolls of $\frac{3}{4}$ -in. cotton tape, 30 cents; and 6 ft. of rubber-covered portable cord made up with drop switch and attachment plug, 42 cents.

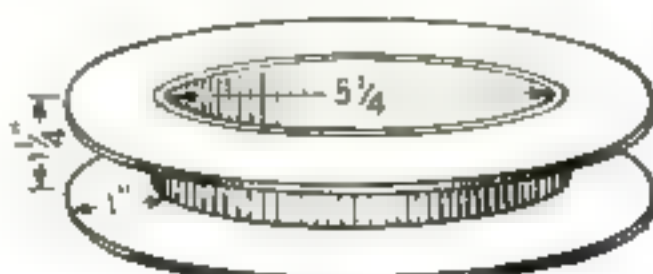
The wire is wound on a heavy cardboard form, consisting of two disks glued to a center ring. The tape may be wound over both form and wire. Wire of a gauge larger or smaller may be used and the insulation may be enamel or cotton.

Plug the coil into any 110-volt a. c. circuit and pass the object to be demagnetized slowly through the coil one or more times. If the object is a watch, hold the coil in a horizontal position, tie the watch to piece of string about a foot long, drop it through the center of the coil, snap on the switch and very slowly lift the watch up through the coil and a foot or so beyond before turning off current. This will not harm any watch.—W. C. CHENEY.



Boring bar and calipers used on an electrically welded cylinder, and the same tools after they had been in the demagnetizer ten seconds

The form is a short cardboard tube and two disks of heavy cardboard or thin plywood

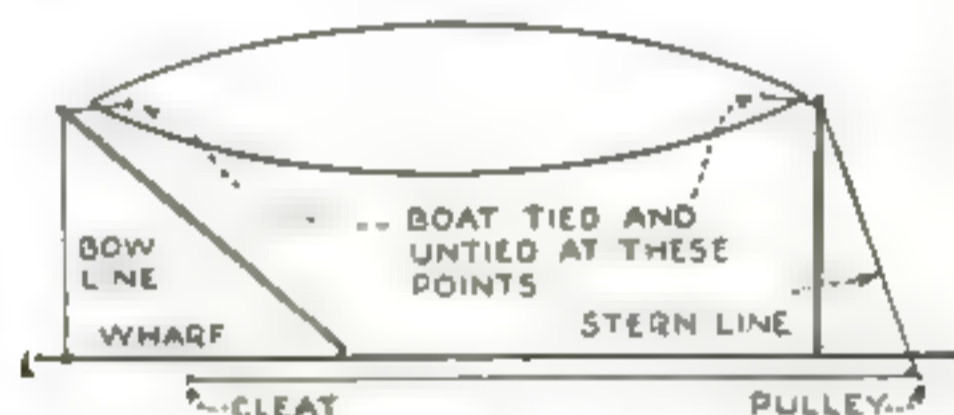


A Safe Way to Moor Small Boats

REGARDLESS of tide, current, wind, or waves from passing boats, the method illustrated of mooring a boat will hold it so securely that it cannot pound against the wharf. As shown in the diagram below, the boat is held in place by two short lines from wooden poles, which are fastened to the wharf with universal joints made of interlocking screw eyes.

Assuming the boat to be headed upstream, the downstream strain is taken by a bow line fastened permanently to the wharf and to the outer end of the pole at the bow. An extension of this line forms the short bow line with which the boat is tied. If it is desired to lock the boat to prevent theft, the bow line may be a galvanized iron chain, instead of rope, fastened strongly to the wharf and locked to the boat with a small padlock. The stern line is the same as the bow line except that, for convenience in handling, it passes through a pulley on the wharf to a cleat near the fastening of the bow line.

When the stern line is released, the bow of the boat may be brought to the wharf by pulling on the bow line, after which the poles are untied from the boat, swung in against the face of the wharf, and hung on hooks, to allow ordinary docking. After the boat is tied to the poles again, a pull on the stern line carries it out to its normal position.



The mooring system. Note that the stern line is carried to a cleat near the bow line

CLOTH STRIP CHECKS STUFFING-BOX LEAK

WHEN an outside stuffing box on a small motor boat becomes loose enough to leak badly and cannot be repaired immediately, as will sometimes happen during a trip or in the midst of a busy season, a temporary inside stuffing box can easily be made by winding a long, narrow strip of cloth around the shaft and pressing it tightly into the hole in the sternpost with a screw driver, as shown at the right. Before this is done, however, the cloth must be thoroughly greased by pulling it several times through a handful of grease.

While this expedient is not intended as a permanent repair, a temporary stuffing made in this way will stop the leak completely, and will partially relieve the outside box of any strain that would make the leak worse.—GUY A. RAFUSE.

To make an emergency stuffing box, a narrow strip of well-greased cloth is pressed into the hole in the sternpost



Outriggers hold the boat from the wharf, but when the stern line is released, the bow can easily be drawn in

Note that the pole at the stern hangs at a right angle to the wharf to accommodate square-stern boats, while the one at the bow is set at a sharp angle so as to relieve the bow line of the considerable strain to which it is subjected when the current is rapid, and also to allow the bow to be brought to the wharf easily. The length of the poles should be about twice the normal tidal range.

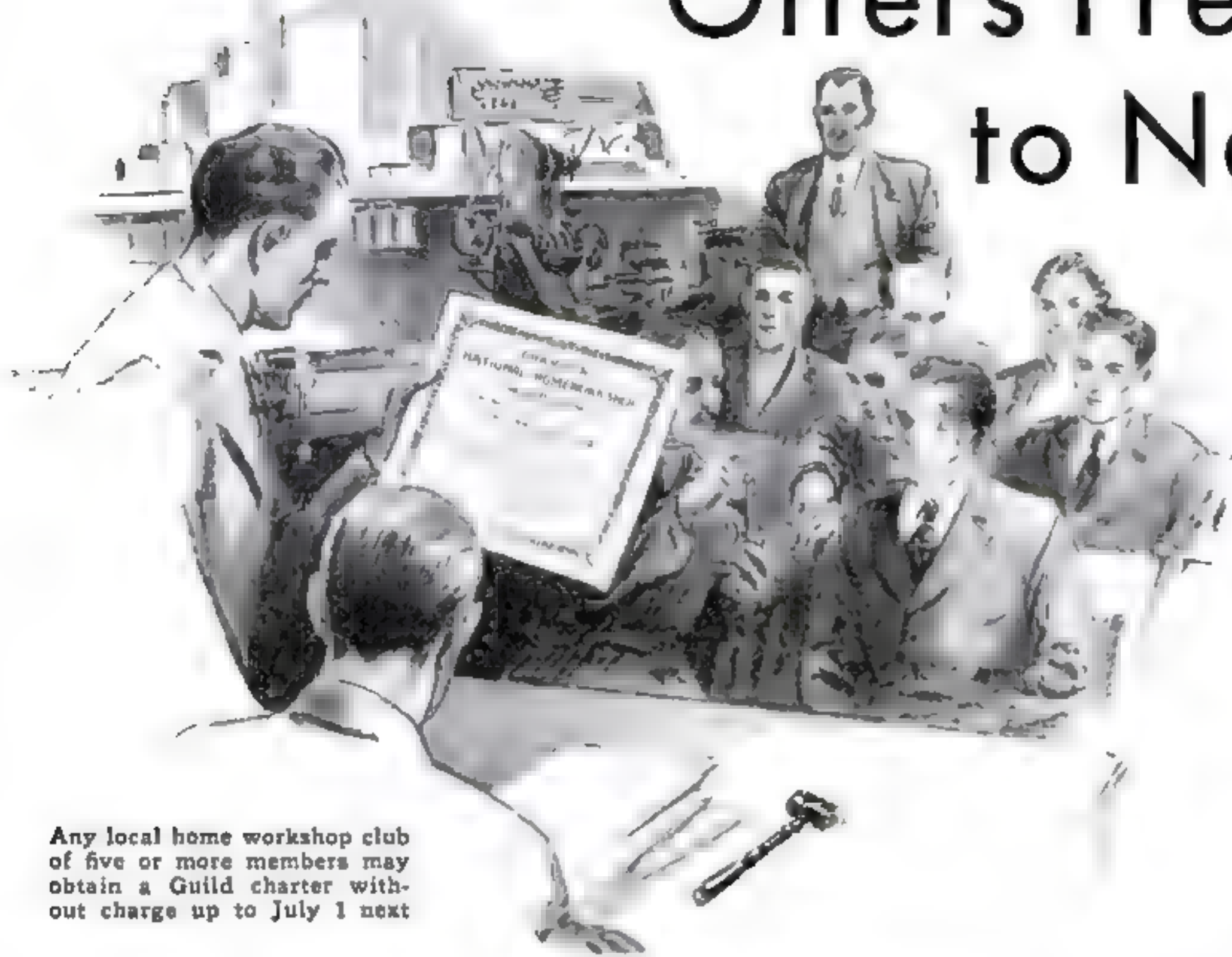
While this may seem to be a rather complicated and impractical method of tying up a boat that is used a great deal, it is an almost ideal system to use for a pleasure boat, which is at rest much of the time; and it should be quite useful at summer colonies where docking facilities are often rather poor.

With this mooring system, the boat touches nothing but the bow and stern lines, is much less subject to casual and uninvited visitors, and yet it is easily accessible at all times.



NATIONAL HOMEWORKSHOP GUILD

Offers Free Charters to New Clubs



Any local home workshop club of five or more members may obtain a Guild charter without charge up to July 1 next

TO SET in motion a new program of expansion, the National Homeworkshop Guild will grant a free charter to any home workshop club of five or more members that submits its application in approved form not later than July 1, 1936.

Not since it was organized in 1933 has the Guild been able to make an offer of this kind. What makes it possible now is the removal of national headquarters to New York, where all Guild activities will hereafter be centralized and where the facilities are much greater for rendering efficient service to local clubs throughout the country.

If you are interested in the home workshop hobby and want to enjoy the benefits of being affiliated with the great parent body of the home workshop club movement, here is your chance. Take advantage of it at once and organize a home workshop club in your own locality. The offer is also open to any home workshop and model makers' clubs which were previously organized, but have never become affiliated with the Guild.

The conditions are simple and easily complied with. They are exactly the same, in fact, as those under which all 187 clubs in the Guild have been successfully organized, except that heretofore every application has had to be accompanied by what

amounted to an initiation fee of fifty cents a member.

If a club conforms to the following rules, it is entitled to become affiliated with the Guild:

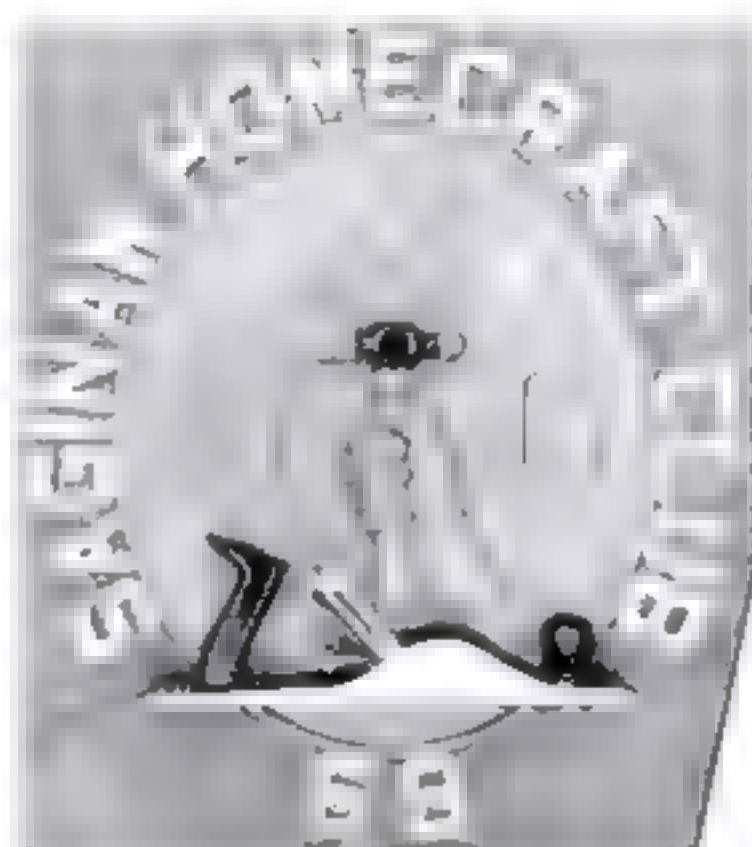
1. There must be at least five members, all interested in some branch of the home workshop hobby. It is not essential that they all have home workshops, but they should be desirous of developing their skill in some type of craftwork. Both men and women are eligible for membership, and

Its facilities greatly expanded by removal of headquarters to New York, it makes special concession for limited time... Additional units organized... Membership is growing rapidly

the minimum age is sixteen years. The club may be located anywhere in the United States or Canada.

2. The club must be regularly organized—that is, it should have two or more duly elected officers and a written constitution—and it must be strictly noncommercial. Meetings must be held regularly and at least once a month. A list of new members and a news report of all special activities must be sent once a month to Guild headquarters.

3. An application for a charter in the Guild should be sent to Guild headquarters. This can be in the form of a letter similar to the sample below, signed either by the president (*Continued on page 88*)



Emblem of the Saginaw (Mich.) Homestead Club made entirely of wood by Merle W. Hedrick

The sample letter below shows the form a club should use in applying for a charter

THE PRESIDENT, HOMECRAFT CLUB

National Homeworkshop Guild
347 Fourth Avenue
New York, N. Y.

Presque, Calif., May 1, 1936

Sir:

We have organized a home workshop club and wish to apply for a charter as an affiliate of the National Homeworkshop Guild. In view of the fact this application is being made before July 1, 1936, it is understood that no initiation fee will be charged our club and that all national dues for 1936 will be waived. On our part we agree to hold regular meetings and report our activities once a month to Guild headquarters. We will send the name and address of all new members monthly to Guild headquarters so that individual affiliate cards may be issued. We also pledge ourselves to keep our club strictly noncommercial.

Our officers are as follows:

President:	John Smith	78 Black St., Fresno, Calif.,
Vice President:	Charles Jones	30 Black St., " "
Secretary:	Henry Jones	30 Black Ave., " "
Treasurer:	Alfred Andrew	40 Black Place, " "

The remaining members are:

Frederick Smith	78 Black Ave., Fresno, Calif.,
Arthur Doe	40 Black St., " "

In addition to the charter, please send individual affiliate cards for each officer and member listed above.

Henry Jones
Secretary
30 Black Ave., Fresno, Calif.

NEW GUILD HEADQUARTERS

THE national headquarters of the National Homeworkshop Guild have been moved from Rockford, Ill., to New York. Please address all mail as follows:

NATIONAL HOMEWORKSHOP GUILD
347 Fourth Avenue, New York, N. Y.

Inexpensive Air-Clamping Fixtures



Fig. 1. Shopmade fixture for holding bushings. The air cylinder is below the drill table

PNEUMATIC clamping fixtures of various kinds have a wide field of application in job shops, automobile shops, railroad shops, and sometimes even in home workshops. Of course, some source of air pressure is required, but there is hardly a shop nowadays that doesn't have a power-driven air pump of some kind for pumping up tires, spraying, or other uses.

A cylinder from an old pump and a little ingenuity will accomplish wonders, especially in saving time on drilling or boring jobs. Such a clamping device is shown in Fig. 1. An old air cylinder is set below the drilling machine table, and as air is let in, the plunger draws down the clamp, which has a diamond-shaped hole in it, thus holding the bushing firmly in the V-block while a hole is drilled in the bushing. A turn of the air valve releases the air instantly, and the bushing is easily removed and replaced by another.

Slight changes in the design of this type of clamp makes it applicable to many purposes. The device shown in Fig. 3 is made on exactly the same principle applied in a different way, but so plainly indicated that no explanation is needed. In Fig. 4 the fixture used is much smaller and is easily removed from the drilling machine table when not needed. A small air cylinder (shown by the arrow) operates the side clamp, which presses a short bar or pin of steel against the V-block, holding it so that a center hole may be drilled in it. Operated by the simple turning of the handle on the air valve, the clamp is much faster and easier than any mechanical method depending on levers, screws, or blocks.

Since air clamps of this kind are generally made from scrap stuff, exact dimensions would be of little use. However, the accompanying drawing (Fig. 2) may be of some assistance. The air cylinder used may be anywhere from 2 to 8 in. in diameter,

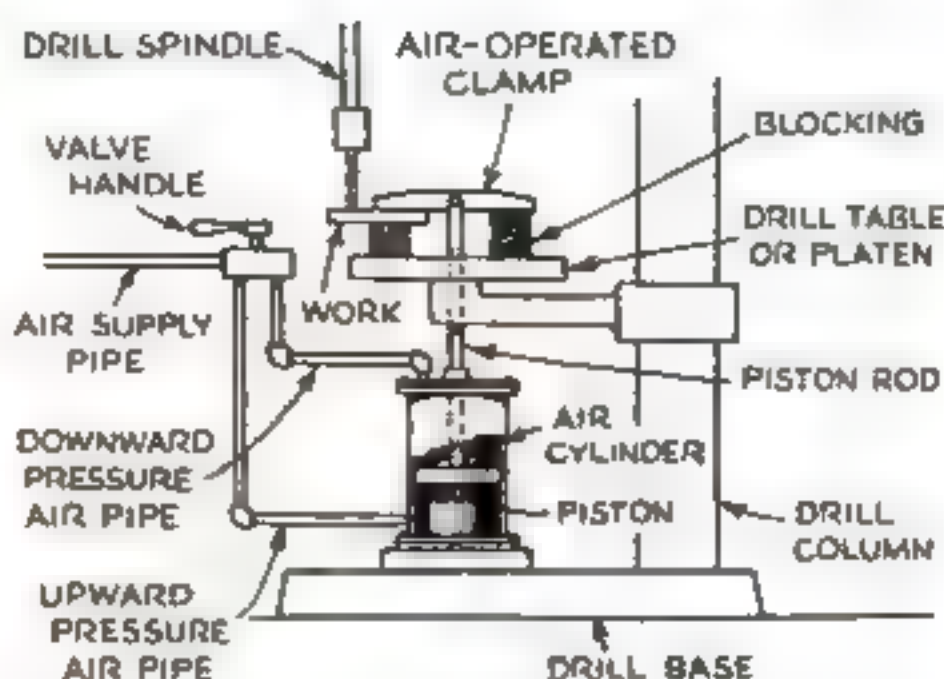


Fig. 2. Diagram showing typical arrangement of parts for a pneumatic drill-press clamp

and the same in height or stroke. A good size is 4 in. in diameter with a stroke of 8 in. The piston rod can be from $\frac{1}{2}$ to $1\frac{1}{2}$ in. in diameter, but in any case should be stiff enough to not bend easily if the clamp happens to pull rather hard to one side. The bar used across the end of the piston rod which does the clamping may be from $\frac{3}{8}$ to $\frac{3}{4}$ in. thick and from 1 to 2 in. wide. The length may be from 6 to 12 in. or more, according to the size of the work to be done and the pull exerted when the air is on.

The air pipes may be from $\frac{1}{8}$ to $\frac{3}{4}$ in. in diameter, according to what scrap pipe can be found readily. Aside from the cylinder, the most important part is the operating valve, which is worked by hand. This should be a three-way valve so made that by setting the lever in one position the air will be admitted to one end of the cylinder and allowed to exhaust from the

other, and by shifting the lever to another position, the opposite effect will be obtained. Such valves may usually be found around car shops, railroad shops, junk yards, and so on, and may be obtained for practically nothing. If not broken or too badly worn, they can easily be repaired sufficiently to handle the low air pressure commonly used around garages or small shops.

If such a valve cannot be obtained, two pressure and exhaust valves may be used, though these are not as convenient as one with a single lever or handle. One thing to keep in mind is not to use an air cylinder larger than necessary since it would waste too much air; but, of course, a cylinder of the proper size cannot always be found, and an air-clamping device like any of those shown is intended to cost as little as possible for material. All the parts are salvaged.

A great advantage of an air clamp is that one can obtain full clamping pressure instantly, and anywhere within the distance of the travel or stroke of the moving piston.—A. E. GRANVILLE.



Fig. 3. A fixture set up exactly like Fig. 2. Fig. 4 (at left). Clamp for drilling ends of pins. The arrow points to the air cylinder

HOLDER KEEPS MUSIC WIRE UNTANGLED

ALL mechanics who use music wire, whether in the home workshop or in the factory, will be interested in the simple device illustrated below for holding a coil of the wire. It enables the starting

end of the coil to be withdrawn and returned without danger of the coil's getting tangled. Furthermore, it does away with the annoyance of tie wires or string.

In our shop we cut pieces of tin 5 in. square and trim the corners so they will not be sharp. Two of the corners are bent over a $\frac{3}{4}$ -in. piece of steel and the coil of wire is laid inside the holder. The remaining corners are then bent over the coil.

The gauge and diameter of the wire are marked on the bottom of the holder, and a hole can be provided, if desired, for hanging it up.—LEONARD E. FABER.





This lie detector shows all changes in the subject's pulse beat. It is being used to find a certain card

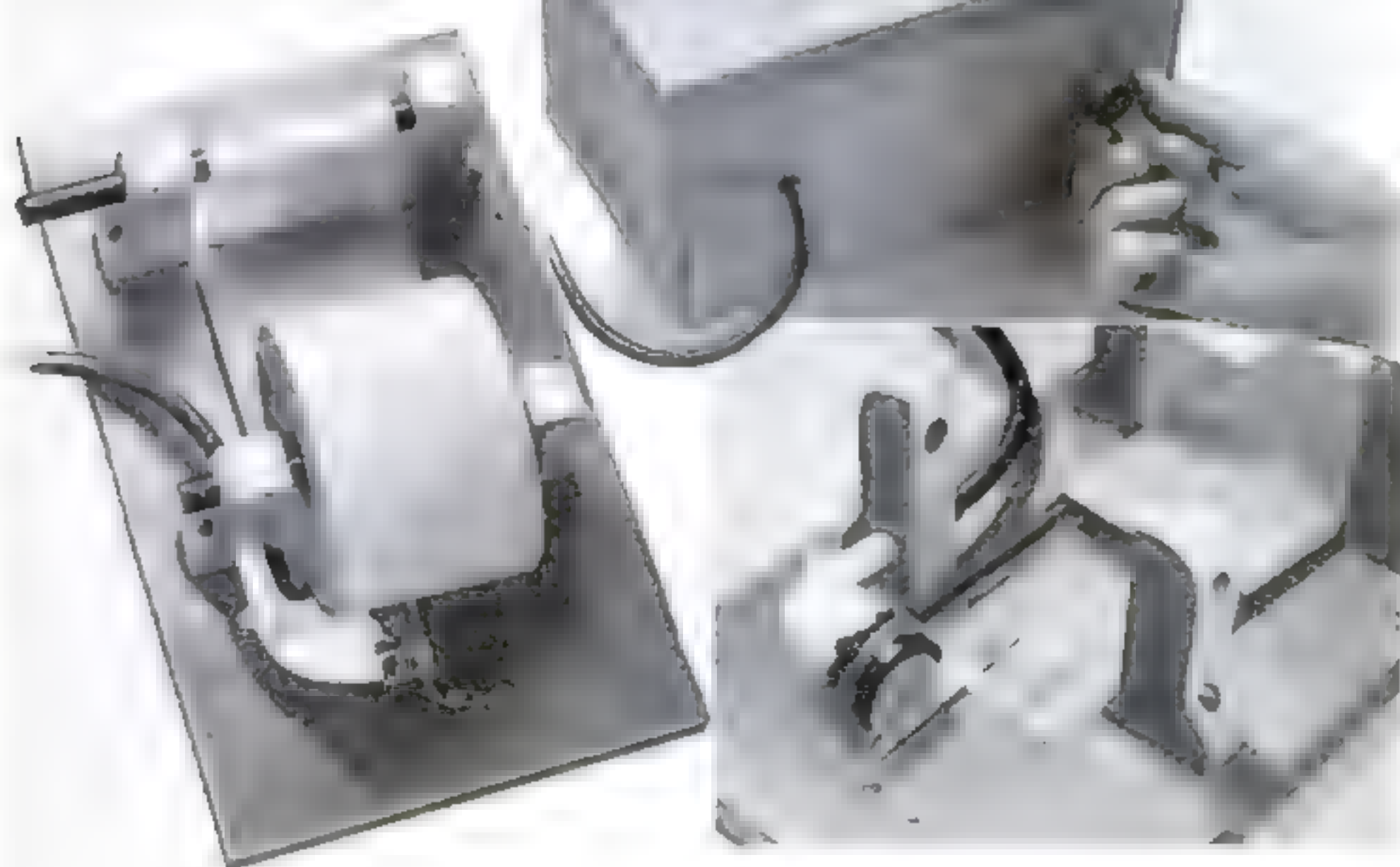
IF YOU think that you can tell a lie and get away with it, test your cleverness against this homemade model of a lie detector or polygraph, as it is often called. With uncanny accuracy it uncovers falsehoods as quickly as you can tell them. While your voice is saying "no," your body says "yes" and leaves a visible record of the truth on this device.

Much amusement can be had by subjecting friends to different tests. For example, have some one choose one playing card from a dozen. Pass them one at a time before the eyes of the person undergoing the test and when he sees the selected card he may say "no," but the indicator of the lie detector will jump and tell that he is fibbing. Although your friend may give no visible indication of this, the sight of the card he chose will instantly cause an increase in his blood pressure, and this is recorded by the instrument. After some one has hidden an object in another part of the house, unknown to you, name the different rooms to him and watch the lie detector. After you have discovered the correct room, it is easy to narrow down the location to the exact spot in which the object is hidden.

Tests such as these always cause amaze-

PULSE-BEAT RECORDER

The indicator hand is moved by air pressure from a rubber diaphragm stretched over a pipe under the box cover



TWO SIMPLE WAYS TO MAKE A Lie Detector

With it you can entertain your friends by performing miraculous card tricks, finding hidden objects, detecting falsehoods, and doing other stunts and scientific experiments

By KENNETH MURRAY



Another type of detector consists of a hand electrode, dry battery, rheostat, and homemade galvanometer like that at the left

ment, and it is just as well not to explain how the instrument works or that there is anything simple about it. Neither is it advisable to ask serious questions of any one undergoing the lie-detector test, for the device will always indicate when the truth is being told, sometimes with embarrassing results.

This model, although it can be easily constructed from simple parts, works on the same principle as the famous lie-detecting instruments used by criminologists

in obtaining confessions of guilt from law violators. It is based on the sphygmometer, a pneumatic device used by physicians for testing blood pressure. Another type of lie detector, which operates electrically and is equally accurate and simple, will also be described.

The "mechanical mind" of the lie detector is an indicating device that records variations of blood pressure on a moving strip of paper. Normally it will make a series of jagged lines, each stroke of equal length. When the subject tells a lie, however, his blood pressure will momentarily shoot up, and the lines made by the indicator will be longer. Since the device itself is so simple, it is advisable to conceal it in a box so as to hide the mechanism and give it as mysterious and complicated an appearance as possible.

The box illustrated is 9 in. wide, 5½ in. deep, and 5½ in. high. The apparatus is attached to the top, in which is cut a 4½ by 2½-in. window, which shows a section of the movable paper tape and the indicator hand. The latter is a narrow strip of metal to the end of which is attached either a pen point or a piece of soft pencil lead.

Attached to the other end of the hand is a disk of tin which rests against a rubber diaphragm (from a heavy toy rubber balloon) stretched over the mouth of a clay pipe. A small wire spring holds the disk against the diaphragm, the arrangement being shown clearly in one of the photographs. Over the stem of the clay pipe is slipped the end of a length of rubber tubing connecting with a rubber bag wrapped around the subject's upper arm. Obviously, any variation of air pressure will affect the

(Continued on page 98)

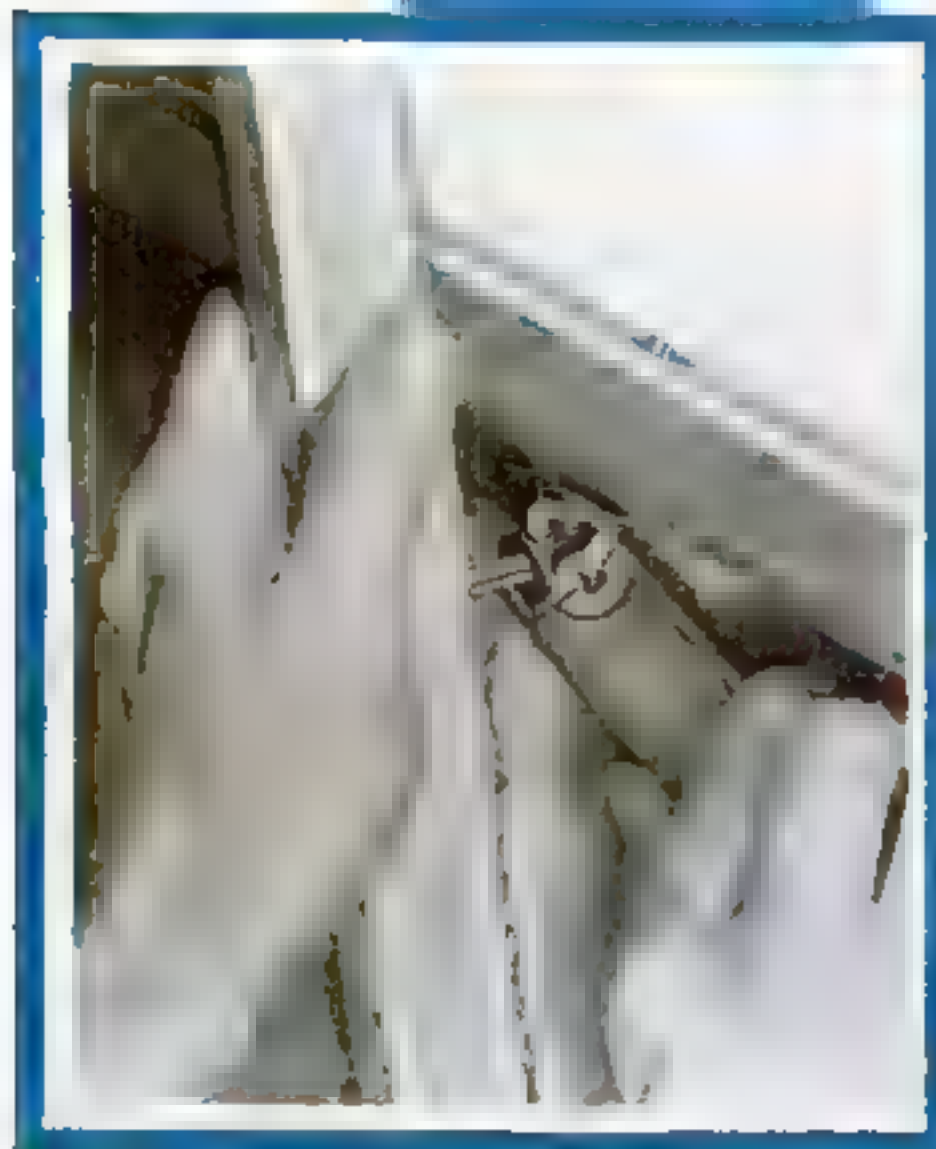
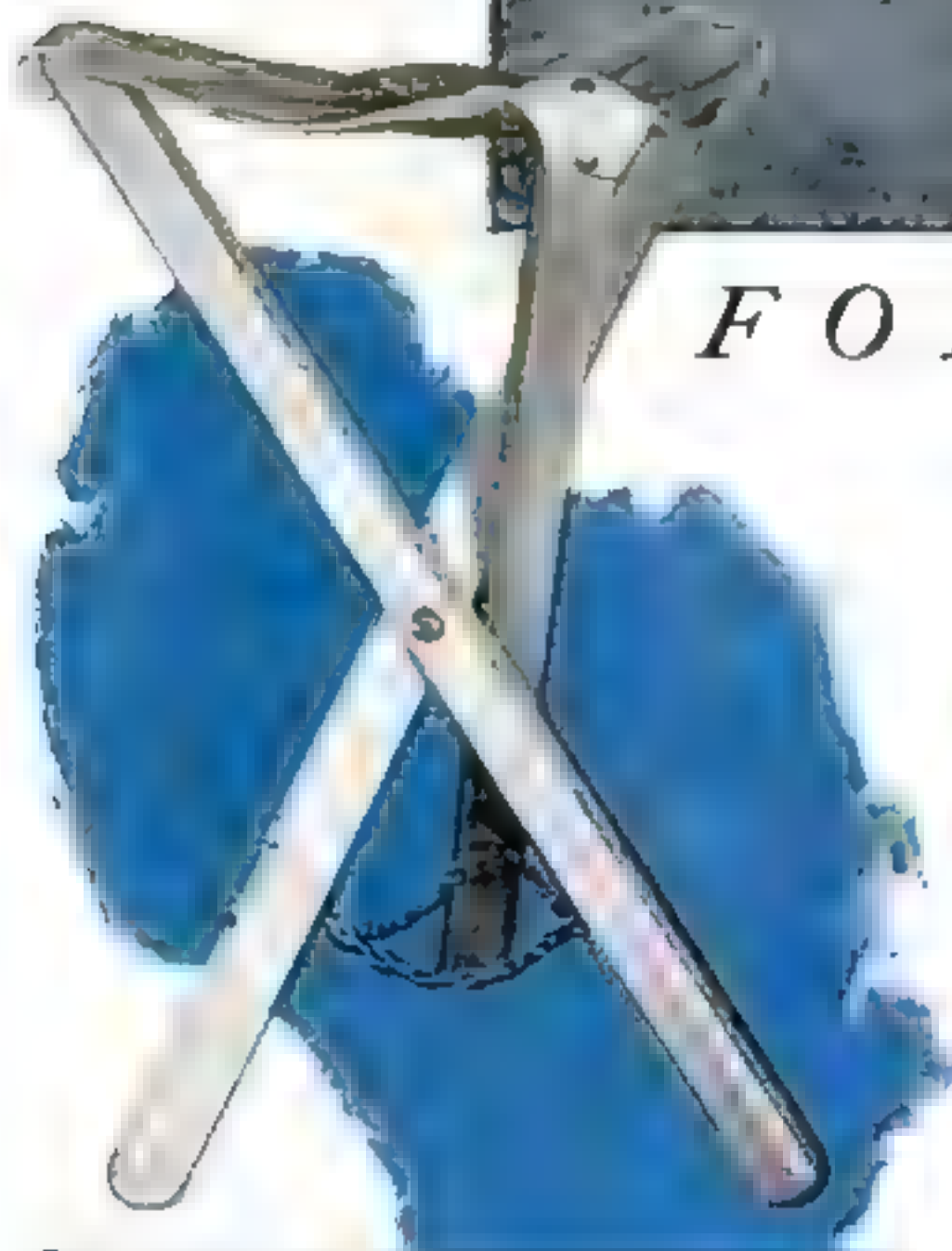
By
IVAN
C.
LUCKMAN

The folding table and chairs are not only useful for camping, but also for an occasional picnic or auto trip. Light as they are, the seats will support a man who weighs 200 lb.

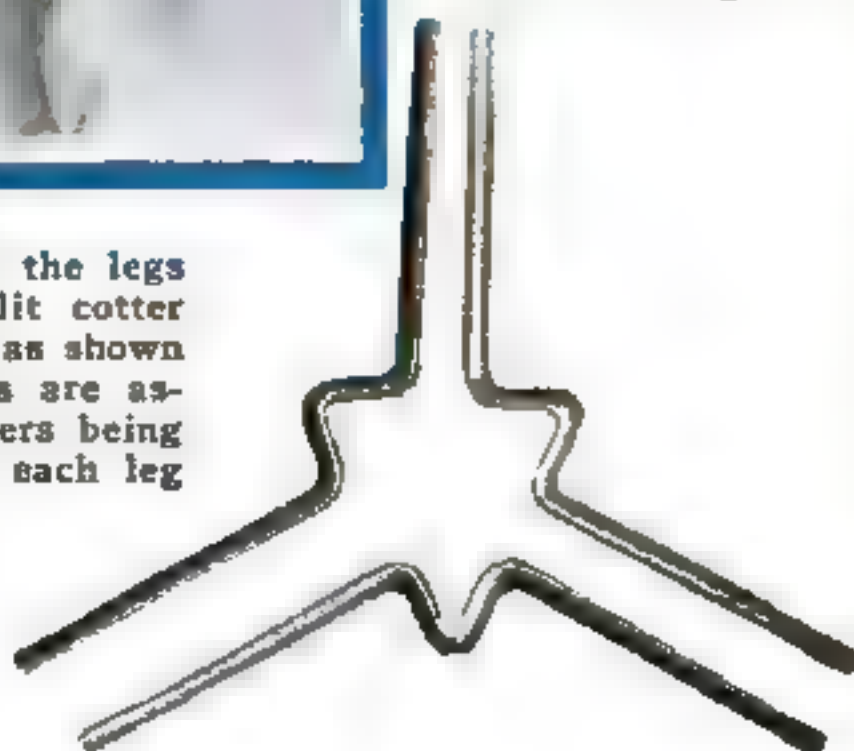


FOLDING

CAMP TABLE



The swiveling joint for the legs is made from three split cotter pins 3/16 by 2 in., bent as shown at the right. The parts are assembled as above, washers being placed on each side of each leg



A FOLDING table-and-chair set that will serve for a prolonged camping trip or automobile tour as well as for an occasional picnic can be made in the most modest workshop. It consists of a sturdy table 24 in. square and four seats, all of which can be packed in a container 8½ by 9 by 24 in. Poplar or white pine will serve for the material, although hardwood may be used to advantage for the legs of both the chairs and the table.

The seats are each made from three pieces of 1¼-in. square wood, 24 in. long. Drill a 7/32-in. hole in each piece, 12 in. from the end. Take three split cotter pins 3/16 by 2 in. and bend them as shown. Then lay them in the form of a three-pointed star, the three points being equidistant and radial. Slip a ¼-in. cut washer onto each point and assemble the three legs. Place another ¼-in. washer against the other side of each leg and split the pins—that is, bend the ends apart like an ordinary cotter pin. The washers will prevent the legs from wearing from friction.

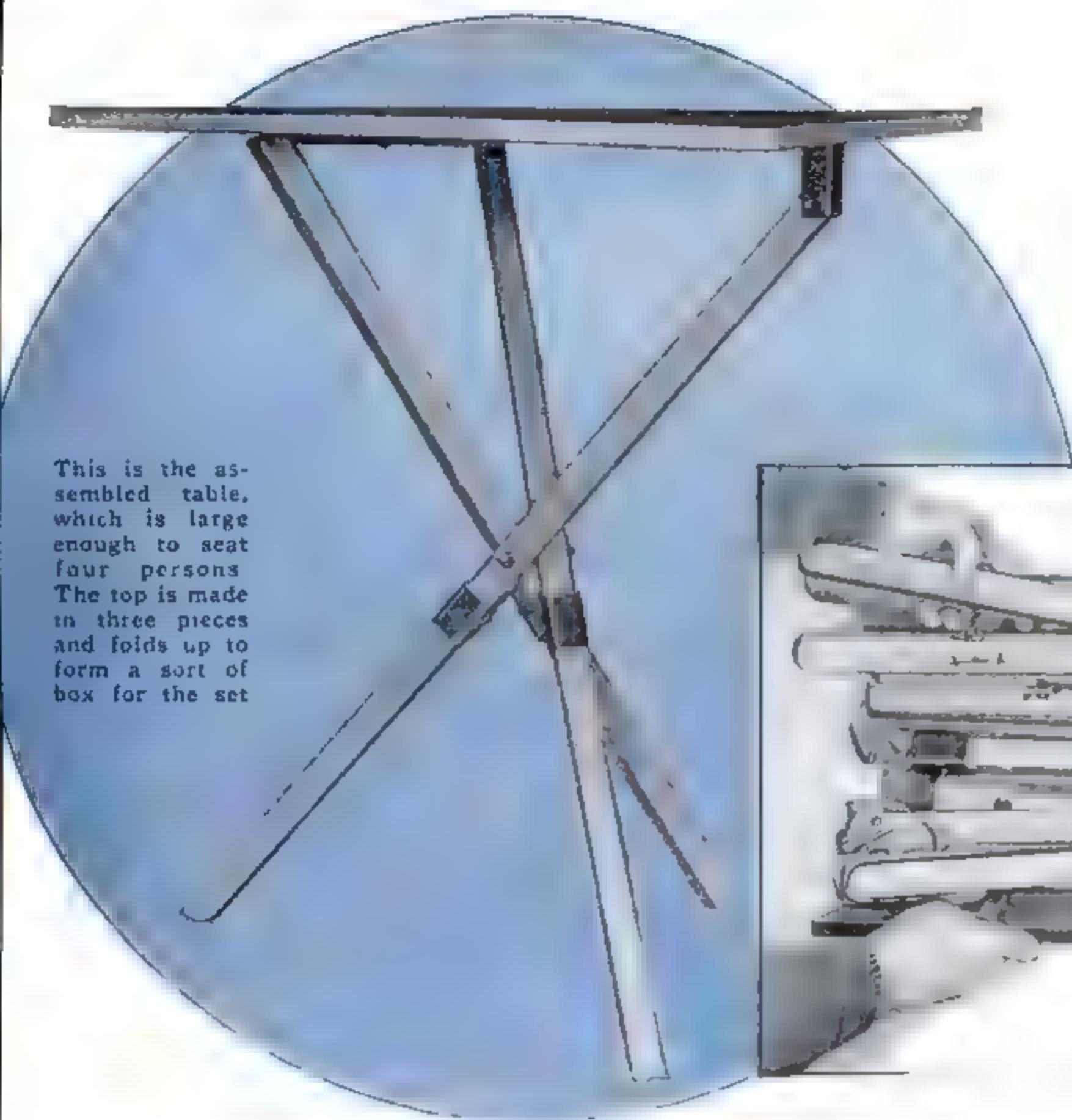
The legs should lie close together when the seat is closed and they should swivel into position easily. Swivel the legs so that their upper ends are about 14 in. apart and anchor the lower ends with a piece of light sash chain, fastened 3 in. from the lower end of the legs. The chain may be secured with staples, but

the better method is to drill the legs and use ¼ by 1½-in. coppers. The upper ends of the legs should be rounded slightly for greater comfort and to protect the seat.

The seat is made from either 8- or 10-oz. duck, cut into the form of a triangle 15 in. long each way and hemmed around the edge. A small patch of the same material should be sewed at each corner so that the fabric is doubled where the seat is fastened to the legs. The triangle is fastened in place with brass-headed furniture nails. Properly made, these seats will support a 200-lb. person without difficulty.

The legs for the table are made from the same size material, but are hinged to facilitate packing. The upper part of two of the legs is 20 in. long, while the third leg is cut 18 in. long so that it will fit properly into the boxlike hinge. The holes for the cotter-pin swivel are drilled 15 in. from the upper end of the short leg and 17 in. from the top of the two longer legs. It is then necessary to drill a 7/32-in. hole ¾ in. from the top of the short leg. The bottom part of each leg is 15 in. long. The leg sections are joined with 1-in. hinges so placed that when the legs are assembled, the hinges are downward.

The legs are further stiffened with U-shaped channels made from 1/16-in. sheet iron, 2 in. long. Bend these channels by clamping the iron in a vise together with a hardwood or metal block of the same thickness as the legs. The sheet iron forms easily, and a workmanlike job will result if you use a block of wood instead of a hammer to force the metal around the form. You will need one channel section for each leg. Be sure that the chan-



This is the assembled table, which is large enough to seat four persons. The top is made in three pieces and folds up to form a sort of box for the set.

How to construct portable furniture for serving outdoor meals. . . . The complete set can be packed in a small bundle....Materials are inexpensive



When the table is folded, the four seats are readily packed within it as illustrated at the left. All are then slipped into a canvas carrying case, which appears below. The complete outfit weighs about 9 lb.

and CHAIRS

nels fit the legs snugly, and fasten them to the legs with wood screws.

The hinge for the short leg also is made from 1/16-in. metal, but is cut 5 in. long. After bending it to shape, make a saw cut in each corner for 1½ in. and bend these ends at right angles to the body of the hinge to form the support for fastening the hinge to the top of the table. A hinge of this design is necessary in order that the legs may be folded compactly for packing the outfit. This hinge is fastened to the top of the table by screwing it to the centerboard, 2 in. from one edge.

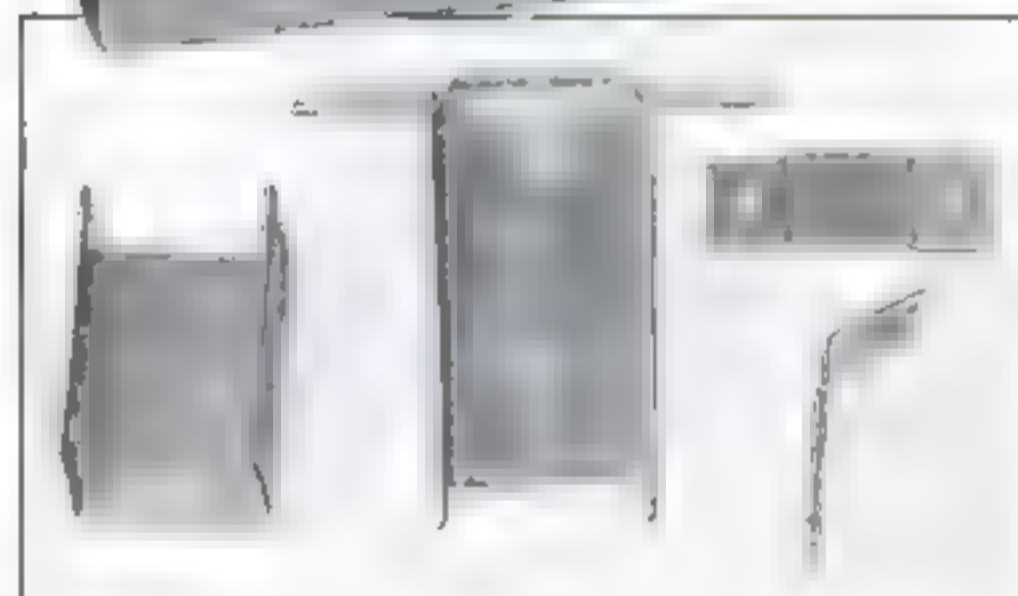
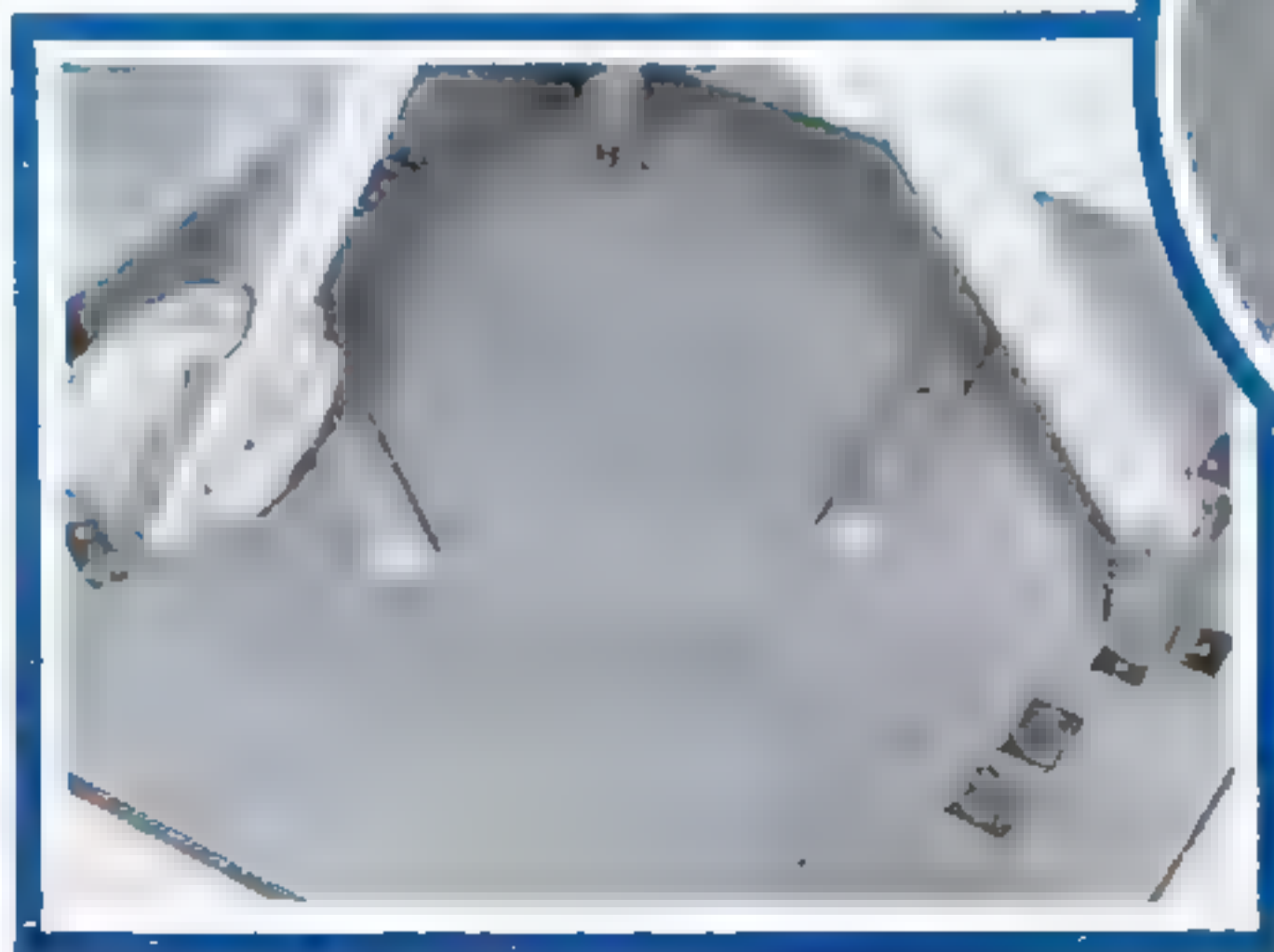
From the same gauge sheet metal, cut two pieces ¾ by 2 or 2¼ in. to form clips for fastening the remaining legs to the table top. These pieces are bent in the center to an angle, as illustrated, so that one face will fit against the underside of the table top

Two of the table legs have clips like that shown below. These are screwed on so that there is a space of 3/32 in. between the bent end of the clip and the top of the leg

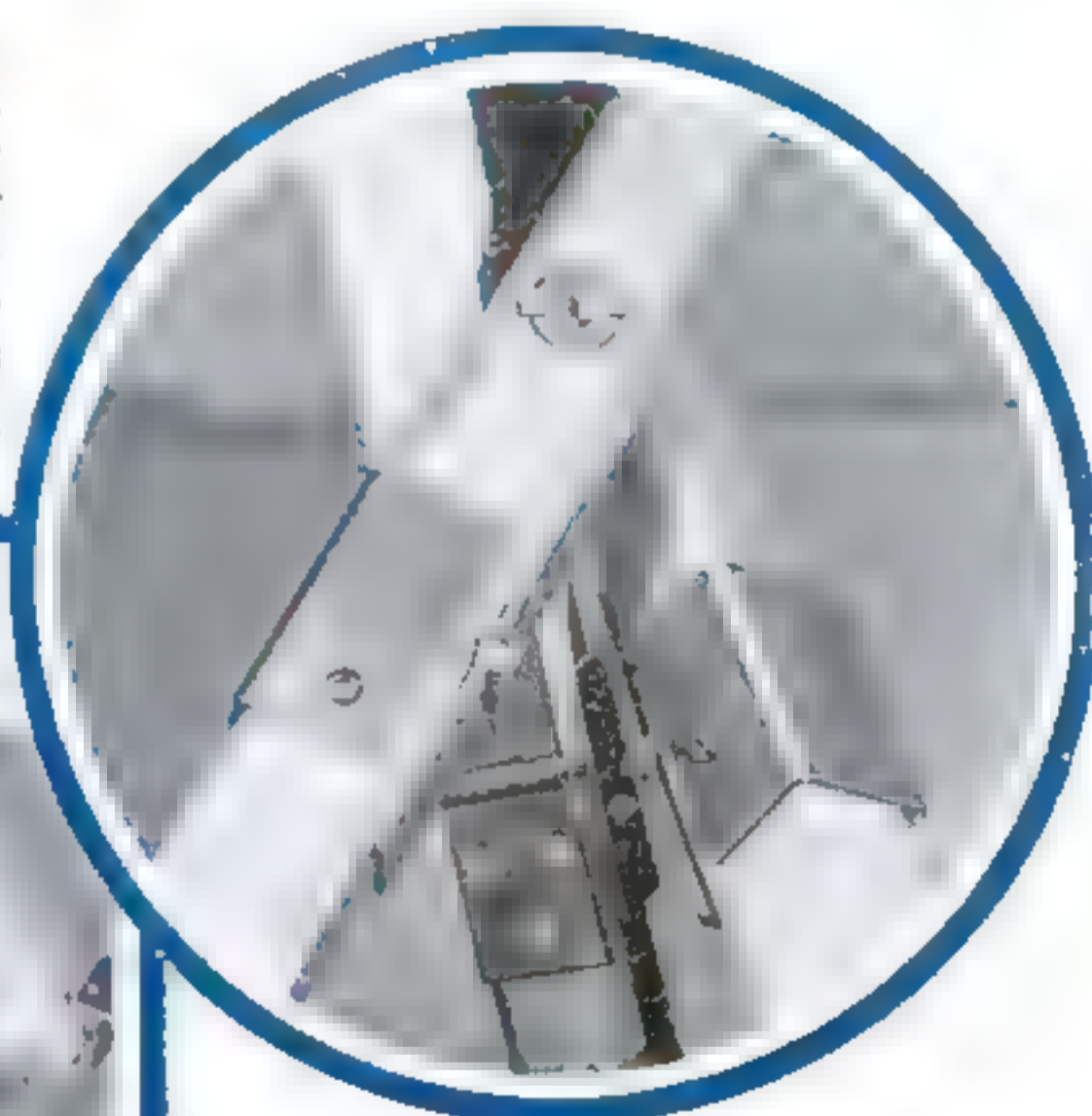


when the legs are opened to their proper positions. The upper ends of the legs are, of course, first cut to this same angle, which will be about 40 deg. It will probably be more satisfactory to cut them to fit and thus compensate for any slight errors in dimensions. The metal angles are fastened to the legs so as to leave a gap of 3/32 in. to permit their entry into the sockets.

The sockets are formed from ¾ by 2½-in. sheet metal, bent over a piece of the same metal to form the shape shown. The exact location for the sockets is likewise best determined by trial, because if they are slightly out of square with the strips on the legs, *(Continued on page 83)*



The various pieces of hardware required for the table are easily made from 1/16-in. sheet metal



The table legs are hinged on the underside just below the swivel joint and are reinforced with sheet metal that has been bent to a channel shape. How the legs are fastened to the table top is illustrated in the view at the left

THIS MONTH'S
BEST IDEAS IN **Distinctive New**

Miniature Brazier . . . Hanging Shelves . . .

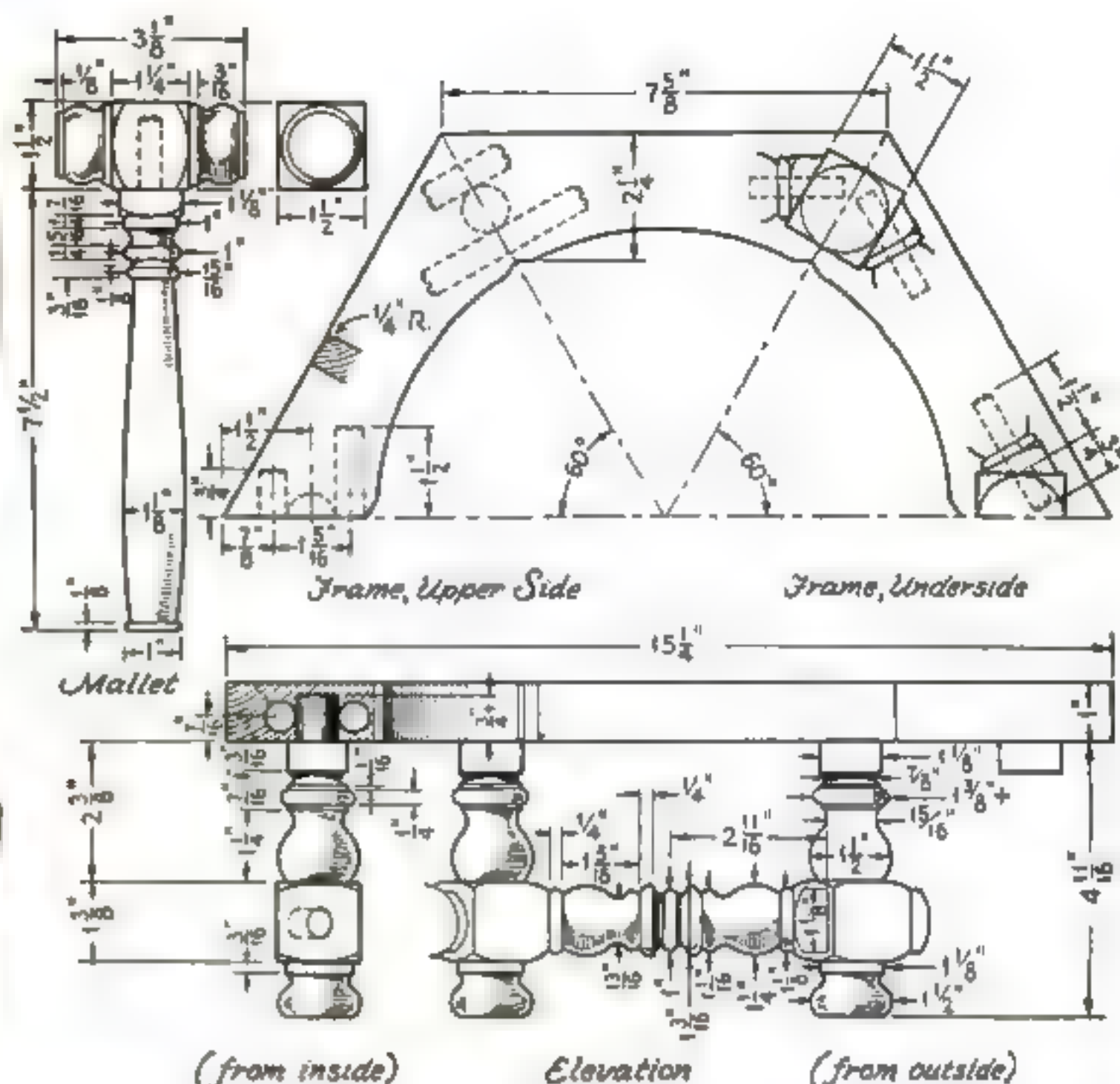


The brazier used to hold a Japanese arrangement of chrysanthemums; and, at the right, as a nut bowl



A MASSIVE Spanish brazier with its pot of glowing coals, warming the lofty halls of an old Majorcan home . . . The very thought sends one's imagination wandering back into the romantic past! Something of that appeal is suggested in the walnut miniature pictured here. Redesigned as a stand for flowers, or fitted with brass anvils and supplied with a mallet for cracking nuts, it is well fitted for use in a modern home.

As the first step in construction, make the six rails that form the hexagonal top frame. Spanish fashion, they are heavy—as thick as you can make them from rough 1-in. stock. A good way to obtain accurate settings of the saw miter gauge for the angles is to make trial cuts on scraps of 1 by 6-in. pine, testing the joint on a full-size drawing of the top. Two or three such cuts should be sufficient. If the walnut

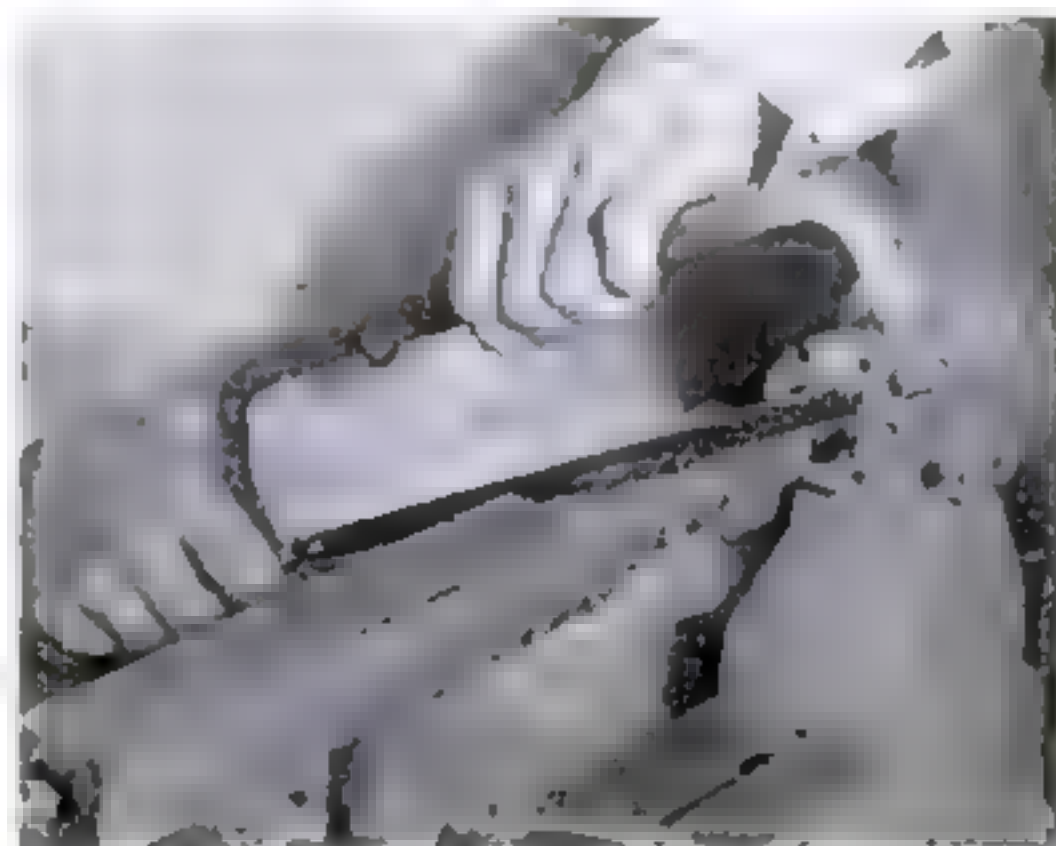


This bowl holder offers good practice in turning small duplicate parts.

rails, when made, do not fit exactly, dress them on a sanding disk, with the table set to undercut slightly, which will insure close joints on the upper side. Of course, these joints can be cut by hand in a well-made wooden miter box.

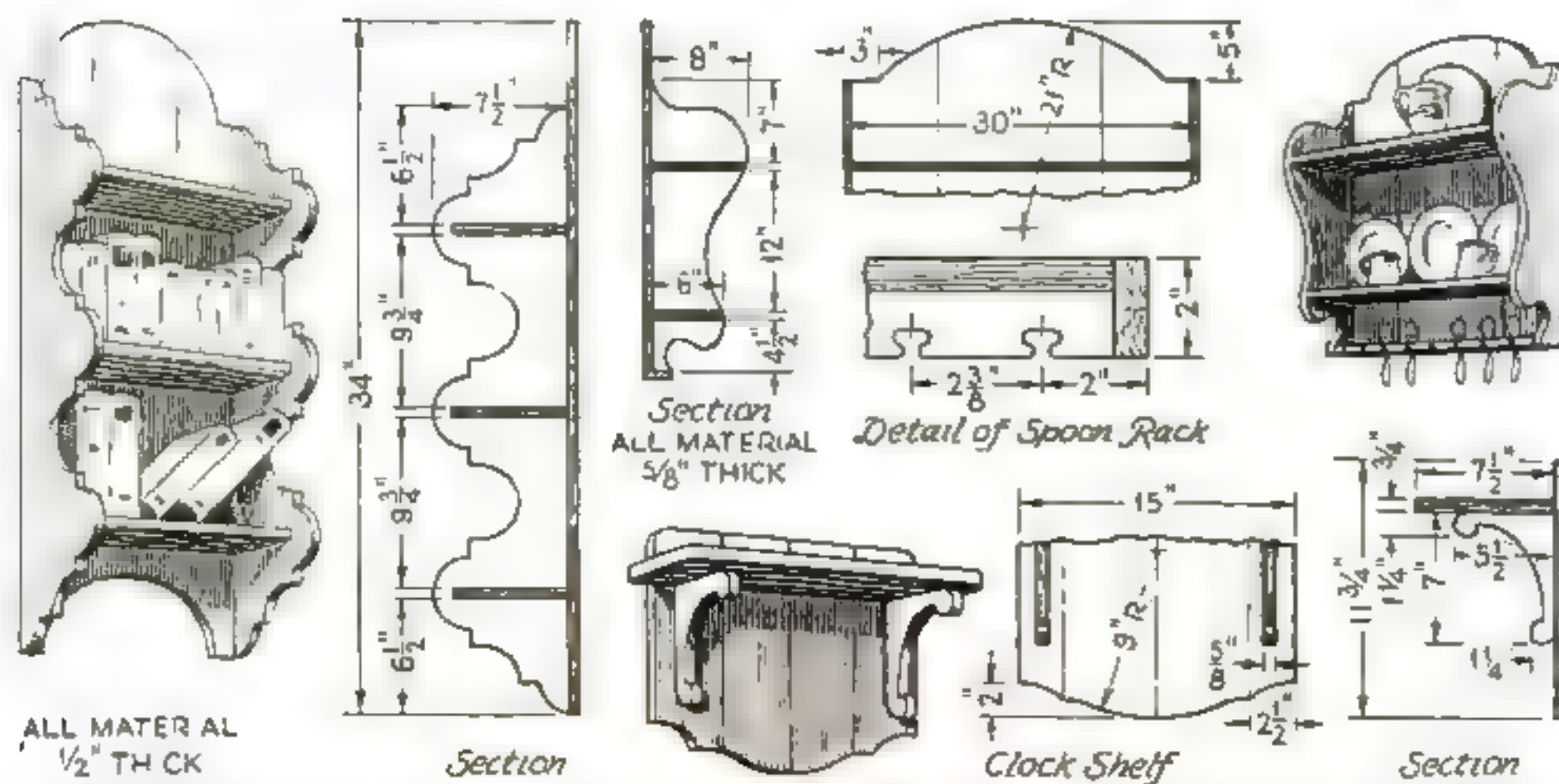
An easy set-up for boring dowel holes is shown in a following photograph. One fence is clamped in such a position that a 1¼-in. slip fence between it and the work will locate the outer dowel hole. This bored, the slip fence is removed, the work is held against the clamped fence, and the other hole is bored. When one end of each is done, reset the fence and bore the other ends.

Before (Continued on page 96)



To avoid splintering the ends of the square sections on the spindles, nick the corners with a skew chisel and finish the cutting with a back saw

THREE EASILY CONSTRUCTED COLONIAL HANGING SHELVES



Working drawings of the three pieces and sketches to show their appearance when hanging on the wall

HANGING bookshelves are excellent home workshop or school shop projects. White pine is desirable for a Colonial effect, but the shelves may also be made of such cabinet woods as mahogany, walnut, or maple.

Laying out and shaping the sidepieces is the first operation. Fasten the two sides together with a brad at intervals where the waste sections occur. Cut both pieces at once with a turning saw or a band saw. File and sandpaper all edges. Next make the shelves. The back, which is the last part to prepare, may be of $\frac{1}{4}$ - or $\frac{3}{8}$ -in. plywood. In assembling shelves and sidepieces, use a dado joint, and fit the back with a rabbet joint. It is advisable to nail as well as glue these joints. Use small finish nails. Fill the nail holes and sandpaper the entire piece.—HAROLD O. AKESON.

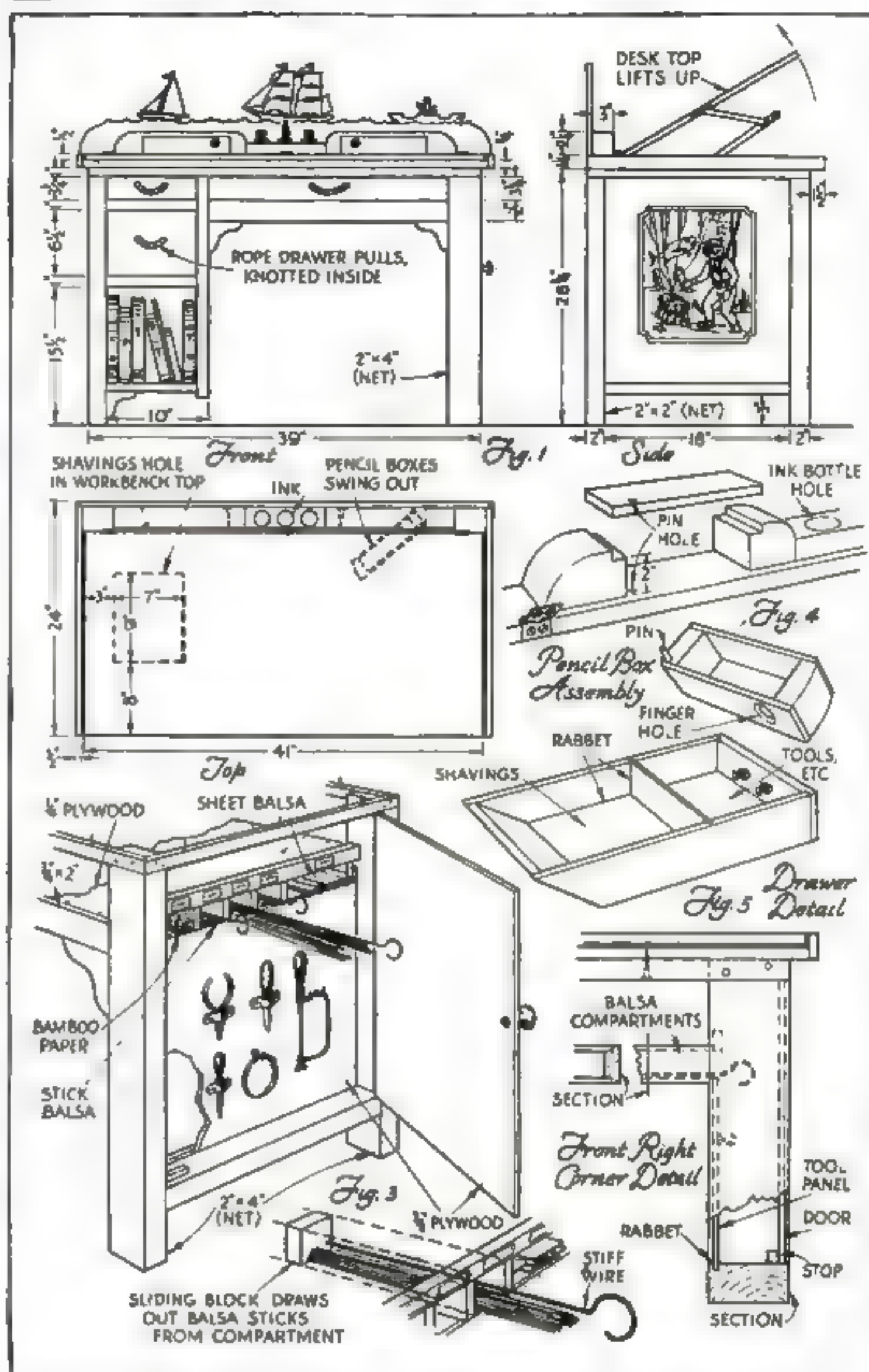
Plant Stand . . . Boy's Workbench and Desk



study and for light
craftwork.

As a desk, it presents a clean, smooth top, with pivoted pencil boxes and, above them, three ships scroll-sawed from a single wooden panel. There is a shelf for books and magazines, and drawer space for paper and other material.

When the top is lifted, it becomes a



General assembly drawings and details of tool cabinet and other parts

workbench for making ship models, airplanes, and other projects—a smooth, unpainted pine bench with a well at one end into which shav- (Continued on page 96)

MAPLE STAND WITH CIRCULAR TOP
HOLDS PLANT OR READING LAMP

IF CAREFULLY made and finished of good lumber, the stand illustrated at the right will amply justify the small amount of material and time required to construct it. The piece was designed for holding a plant, but may be adapted to other uses by slight changes in the dimensions. Maple is an appropriate wood.

The principal point to watch is to see that the half-lap joint with which the feet are fitted together is cut squarely and accurately. After these pieces are cut so that they may be assembled with light taps of the mallet, they are permanently glued together, and the feet bottoms are dressed where necessary to fit some plane surface. Not till then is the 1¼-in. diameter hole bored for the post. To be sure that this hole is bored perpendicular, do it on a drill press if possible. The turned dowel on the lower end of the post is split with a saw cut and secured with a wedge driven from the bottom. If you can swing the top in your lathe, it is well to turn a slight depression in the upper surface. The upper cleat is, of course, run across the grain of the top.

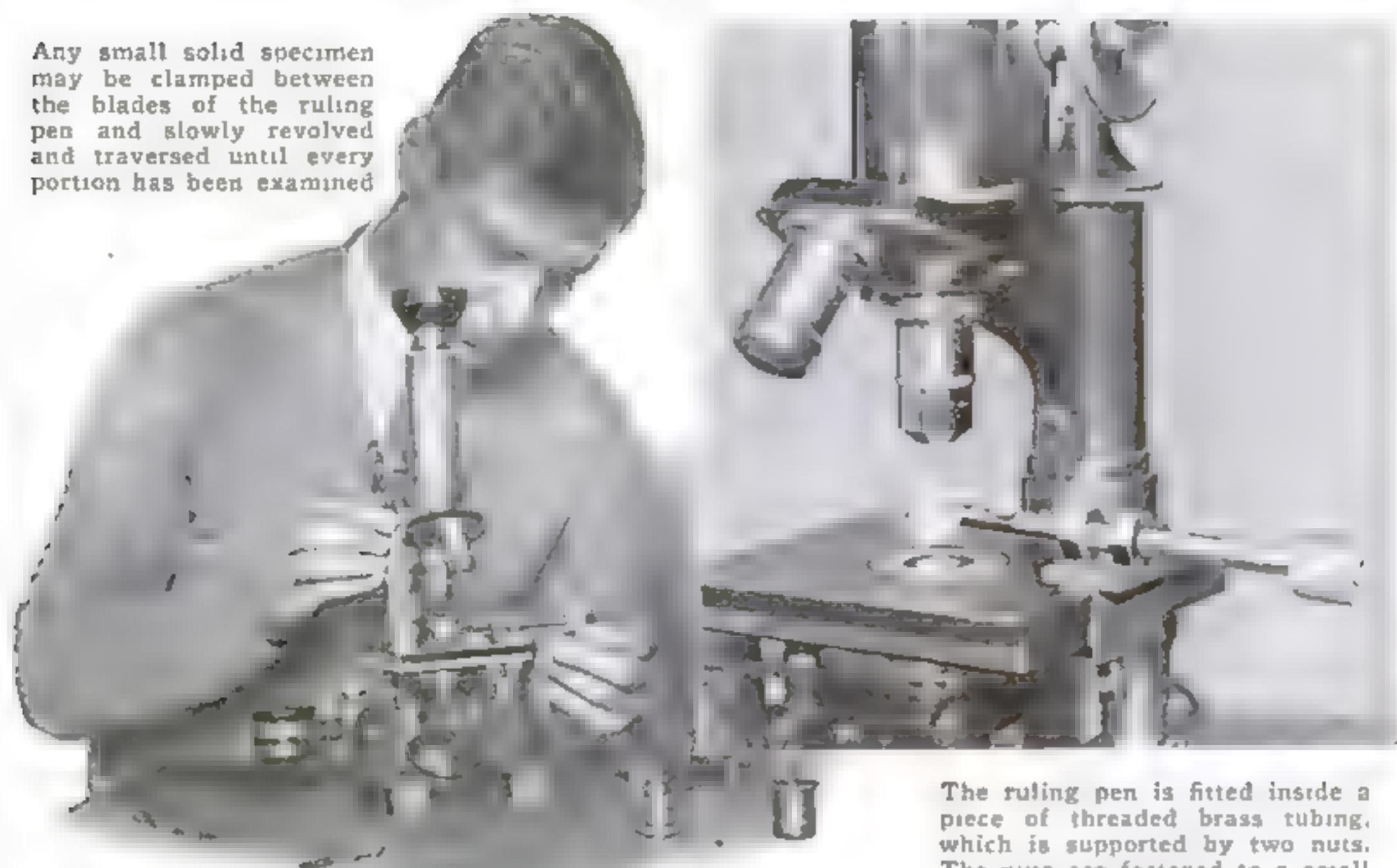
The stand may also be used for a reading lamp, in which case it should be about 30 in. high. Usually 36 in. is a better height for plants.—DONALD A. PRICE.



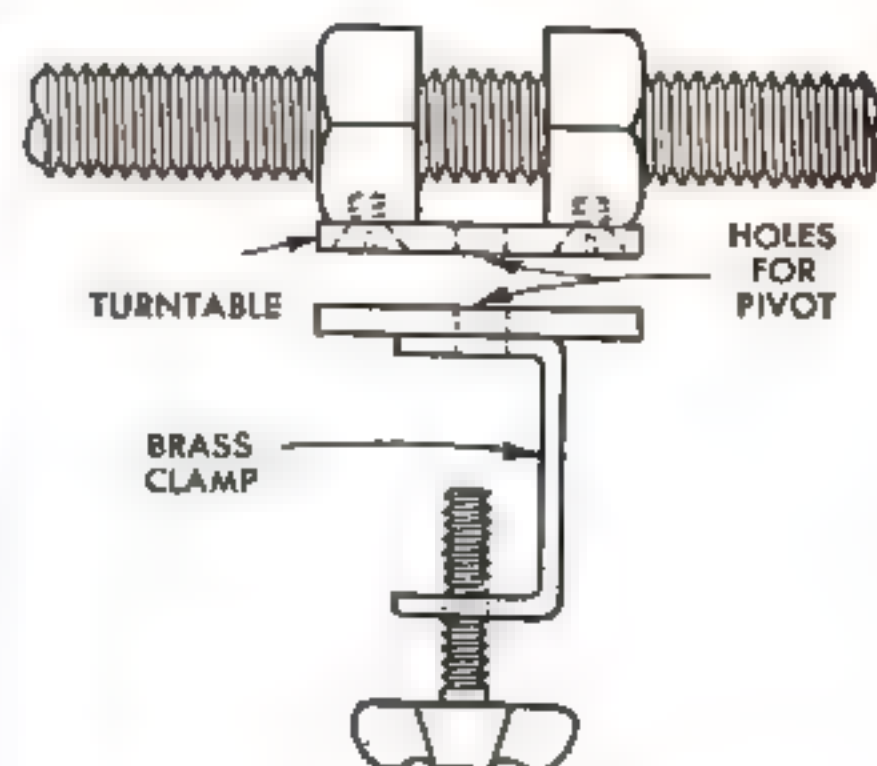
How the stand is constructed and a view of it in use holding a plant

Microscope Stage Forceps Made from Drafting Pen

Any small solid specimen may be clamped between the blades of the ruling pen and slowly revolved and traversed until every portion has been examined



The ruling pen is fitted inside a piece of threaded brass tubing, which is supported by two nuts. The nuts are fastened to a small brass plate, pivoted to the base



A full-size detail of the bearing for the threaded tube, the plate to which it is pivoted, and the clamping device

A CONVENIENT method of holding small objects for observation under the microscope is by means of homemade stage forceps of the type shown in the accompanying illustrations. The forceps may simply be mounted on a 3 by 1-in. brass base, which can be slipped under the spring clips on the microscope stage or held in a mechanical stage if the instrument is equipped with such an accessory. Another method

of fastening the forceps to the microscope stage is to use a brass clamp with a thumb screw, as illustrated.

The forceps are made from a draftsman's ruling pen fitted inside a piece of threaded $\frac{1}{4}$ -in. brass tubing. The tubing is mounted in two nuts to provide for rotation. The other end of the tubing is fitted with a cork, to which specimens may be pinned. The two nuts which sup-

port the forceps are mounted on a turntable base, so that either the forceps or the cork can be brought into the center of the field by rotating the holder end for end. This device is therefore very flexible of movement, and a specimen can be rotated and moved about so that all parts of it may be examined methodically.

This apparatus is useful for the examination of small insects, botanical specimens, fragments of rock, tissues, and other small solid bodies, when precise movements are essential for systematic study.

The microscopist will find it interesting and instructive to watch the feeding routine of various types of insects. This is done by placing sugar and insect on the cork end of the device.—OSCAR FREEMAN.

BUD VASES EASILY MADE FROM WOOD

YOU can make attractive bud or flower vases on a wood-turning lathe. Turn any design you choose, bearing in mind, however, that the shape should not be too heavy unless you are willing to weight the bottom by boring it out and pouring in melted lead or a mixture of lead shot and melted paraffin.

Bore a hole 5 or 6 in. deep into the top to receive a test tube, which may be from $\frac{1}{2}$ to 1 in. in diameter. It is fastened in the hole with household cellulose cement

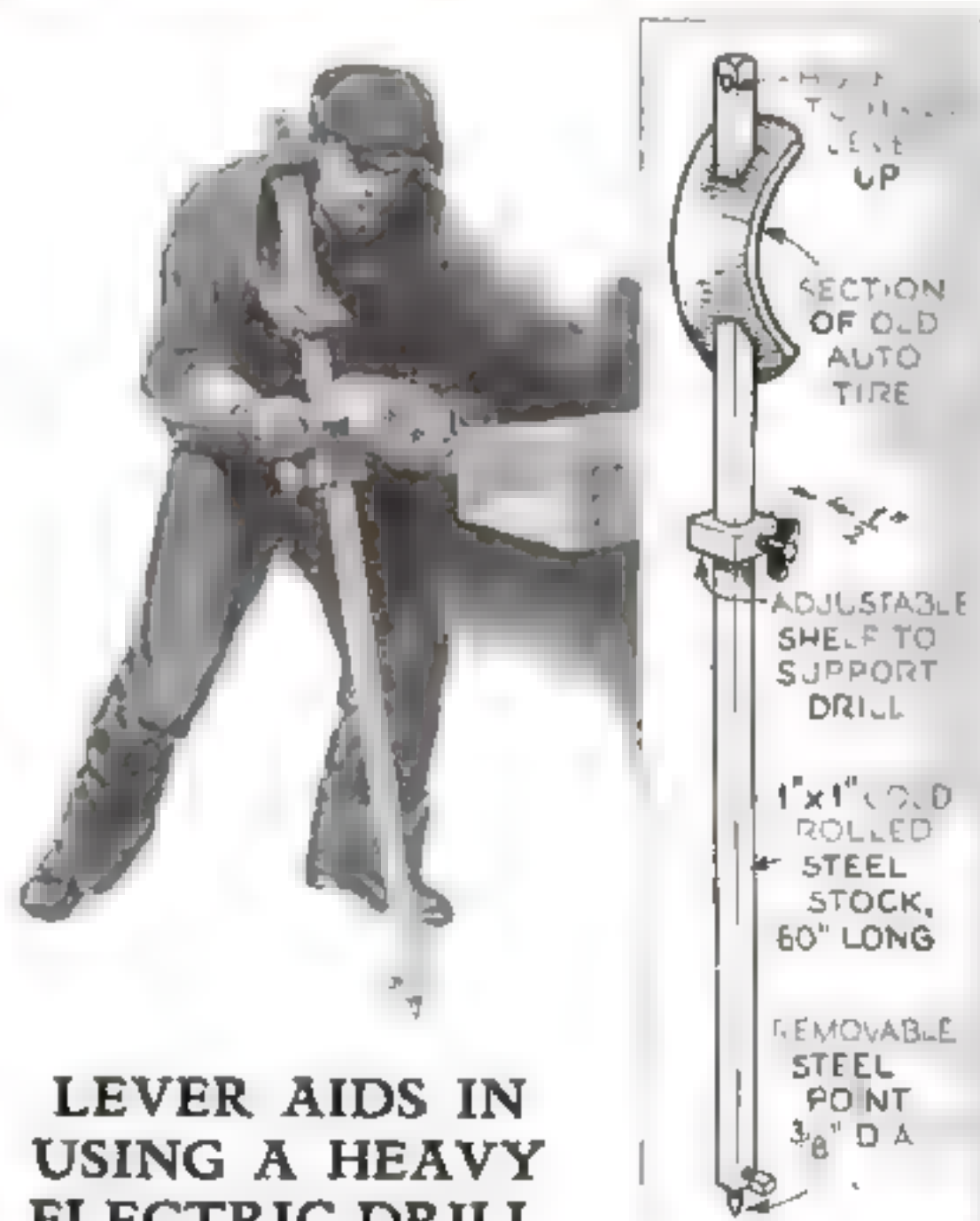
or a cement made by soaking celluloid in a half-and-half mixture of acetone and denatured alcohol until a thick, smooth paste is obtained. The top of the tube should be flush with the top of the vase.

Fill in any cracks or holes with a wood plastic composition, allow it to dry, and sandpaper smooth. Finish by staining, filling with paste filler of the proper color (if an open-grained wood has been used), and applying a very thin coat of white shellac and two coats of a high-grade floor varnish or waterproof spar varnish.

The vases illustrated are from 8 to 9 in. high, and $\frac{1}{2}$ -in. plain-top test tubes were used. The wood was colored with a standard dark walnut stain.—ROLLIN H. WAMPLER



Pair of small flower vases turned from wood. Set into each is a $\frac{1}{2}$ -in. test tube, which is fastened with cellulose cement as illustrated in the view at the right

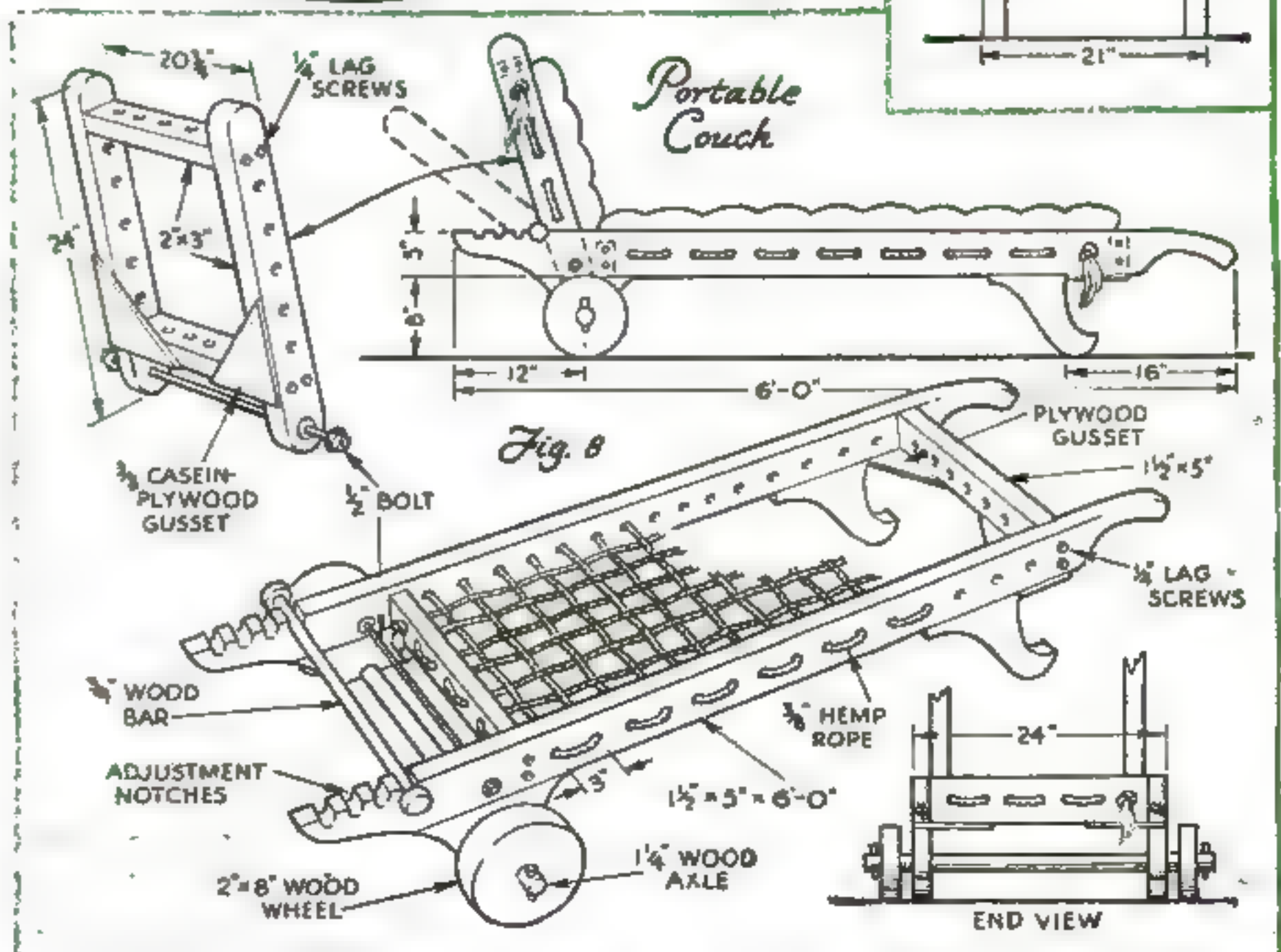
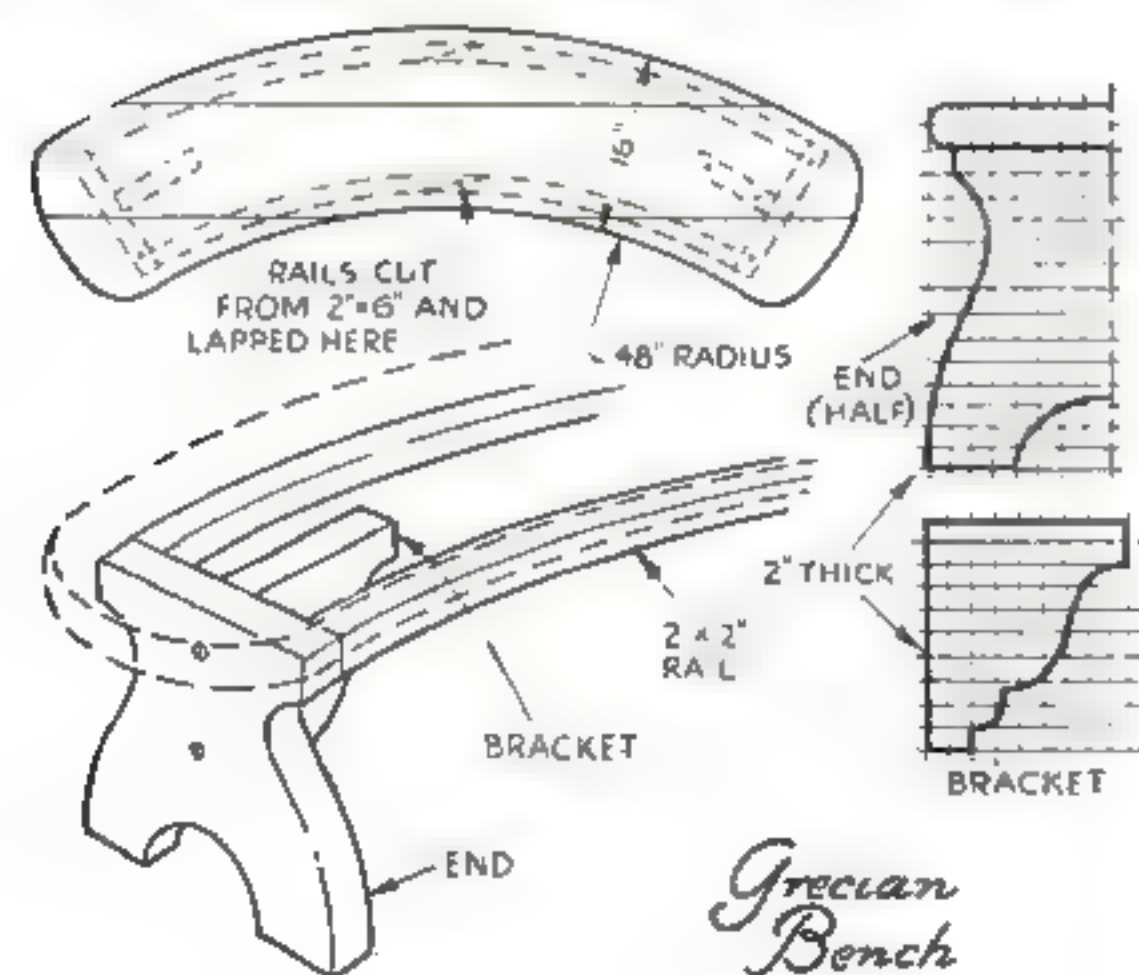
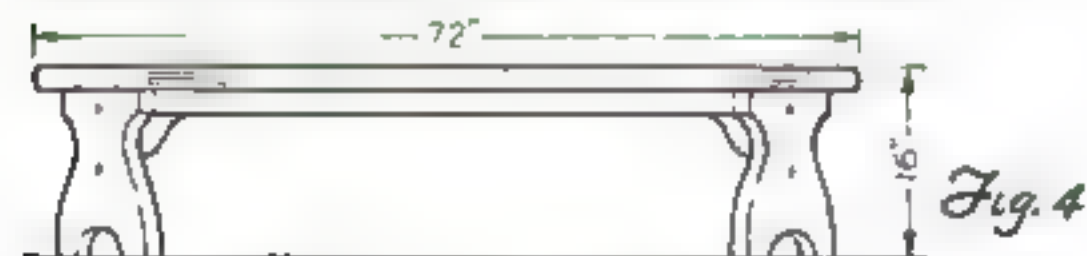
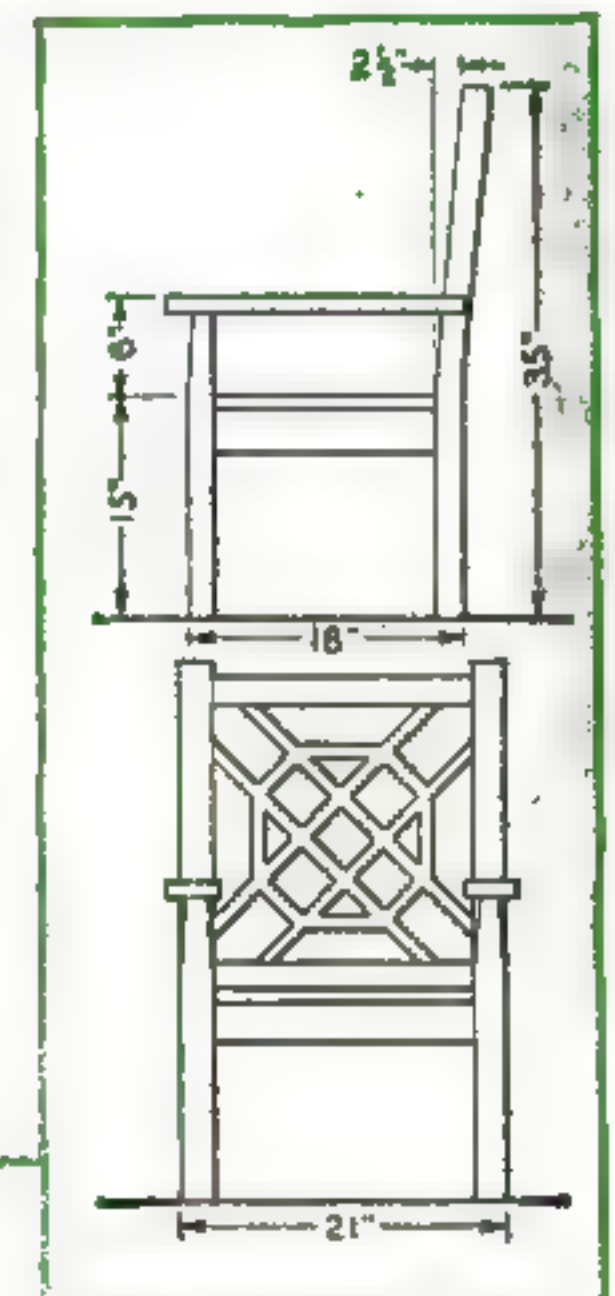
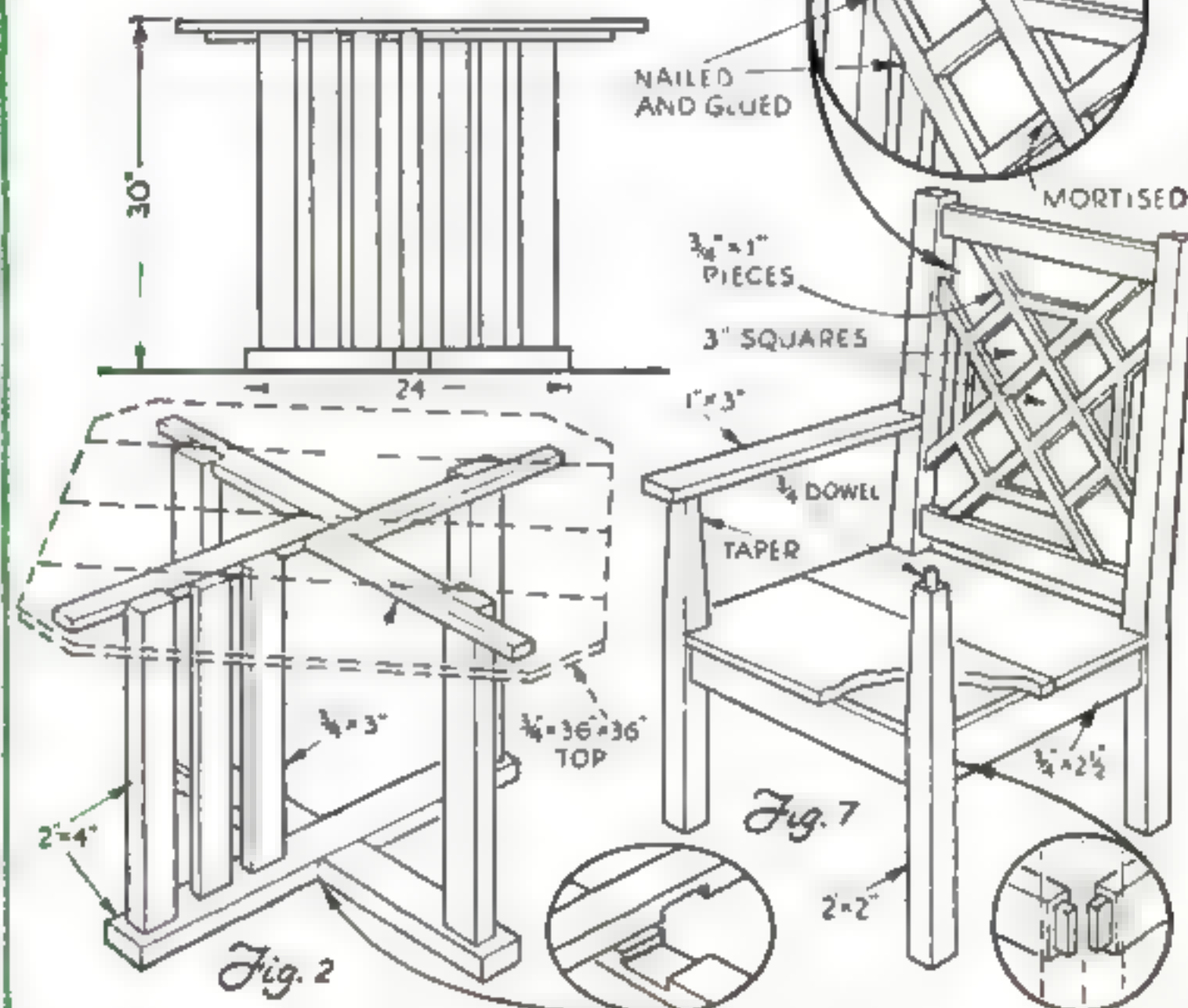
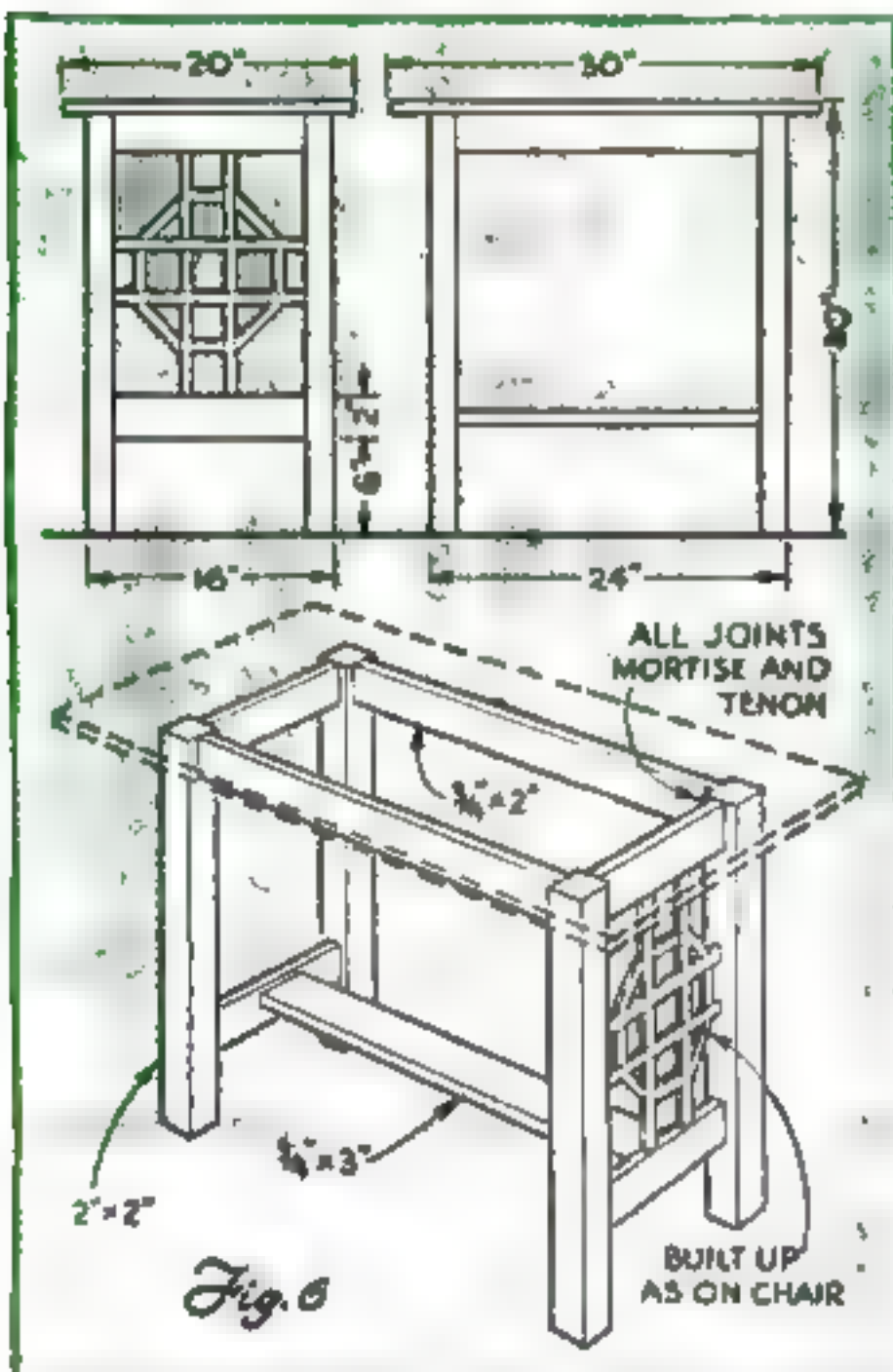
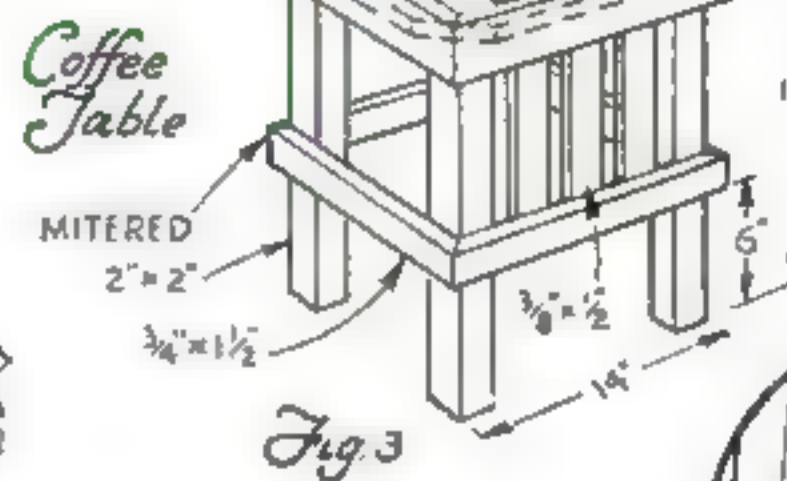
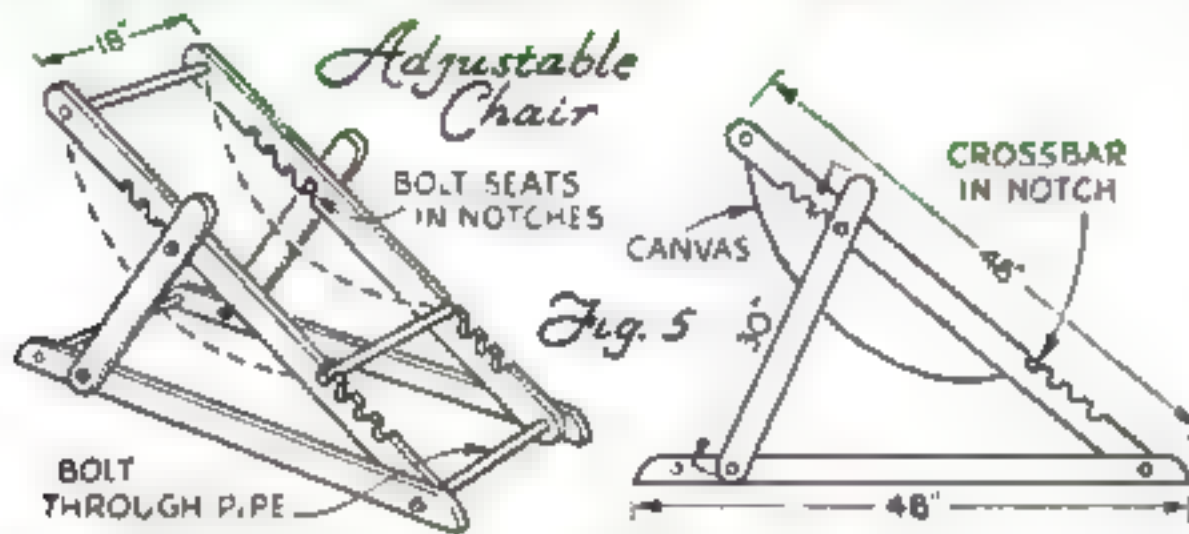
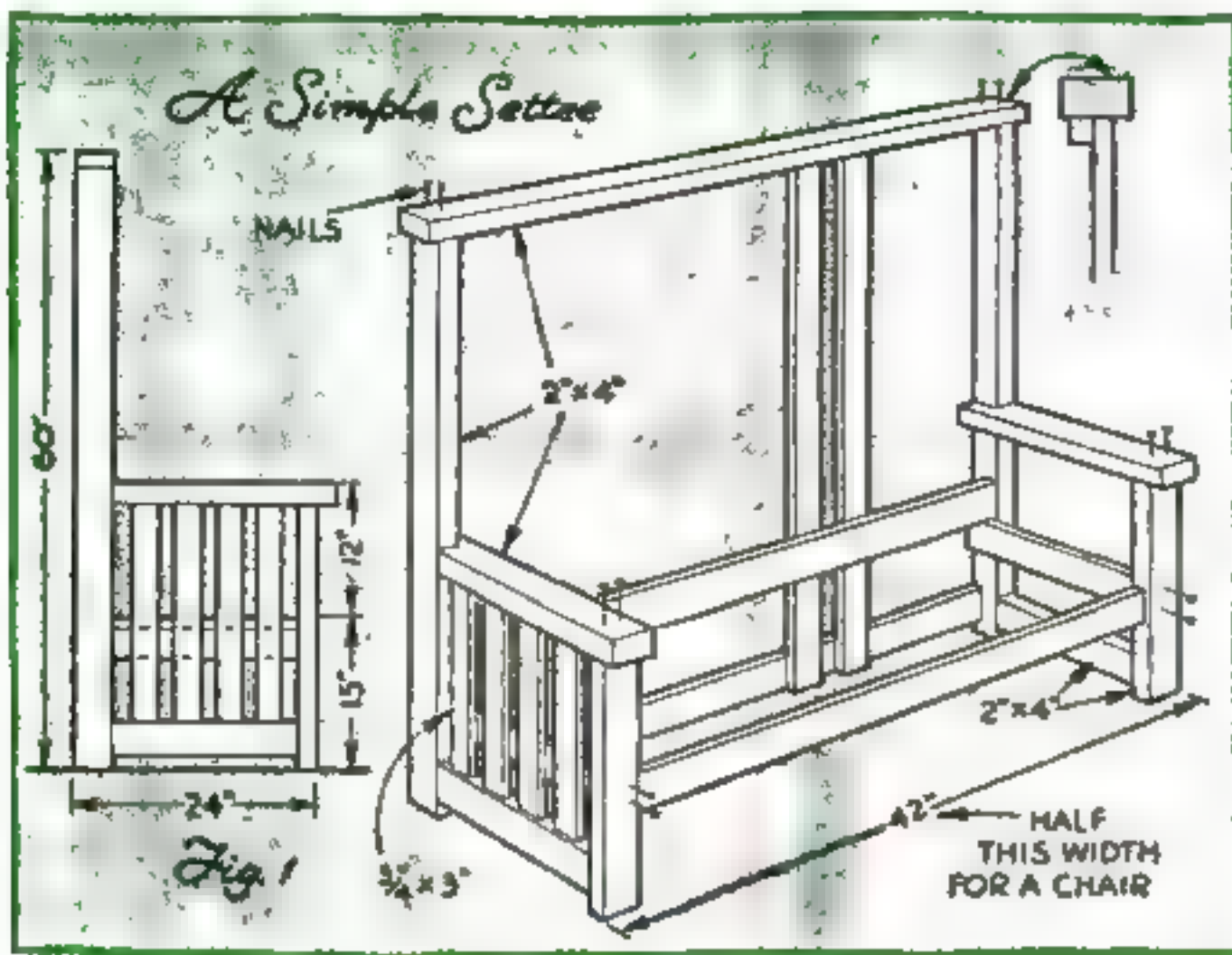


LEVER AIDS IN USING A HEAVY ELECTRIC DRILL

A LEVER of the simple variety illustrated above saves much time and effort when using an electric drill in positions where it is difficult to apply sufficient pressure, particularly when drilling through the vertical faces of large, heavy castings. The lever is made from 1 by 1-in. steel as shown. To use it, first start the hole; then adjust the sliding rest or shelf on the lever so that it will support the drill at the proper height. Prick the steel point firmly into the floor, set the drill in the hole already started, and apply pressure to the lever by bracing a shoulder against the shoulder rest.—ROGER C. DICKEY.

GARDEN FURNITURE

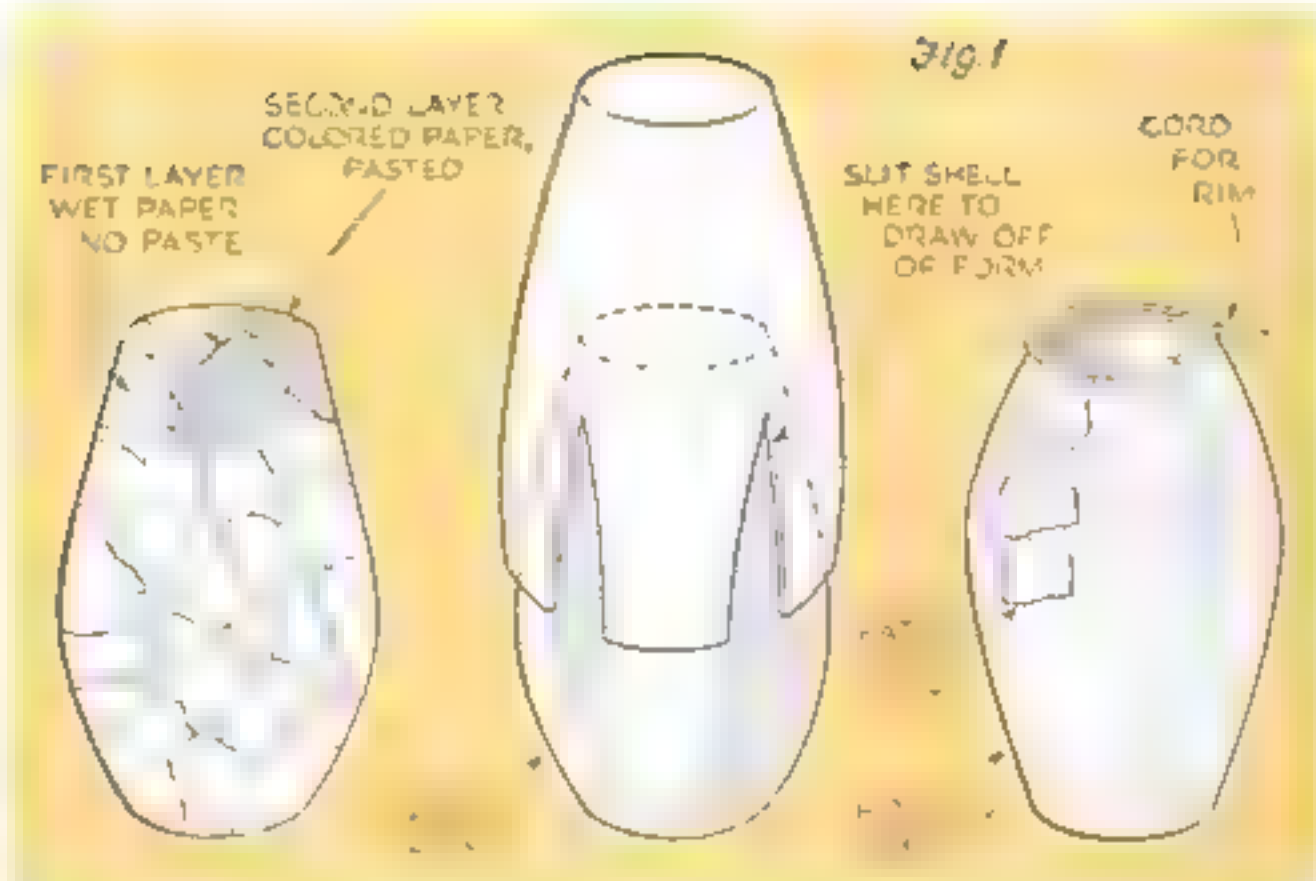
ANY enterprising home landscape gardener should be able to select from this assortment of outdoor furniture two or three pieces well within his ability to construct. Figure 1 is a simple garden seat that requires only hammer, saw, and square to build; and only two-by-fours and $\frac{3}{4}$ by 3-in. material are required, preferably Southern pine if the piece is to be painted. The same size material is used in Fig. 2, with the exception of the table top, which is made up of four $\frac{3}{4}$ -in. boards. Figure 3 is a coffee table, and Fig. 4, a curved Grecian bench. The top of the latter should be about $1\frac{1}{2}$ in. thick. All these pieces are best painted white. Extreme simplicity is the feature of the comfortable reclining chair shown in Fig. 5. A filigree table and chair appear in Figs. 6 and 7. Figure 8 is a couch, designed to have cushions.



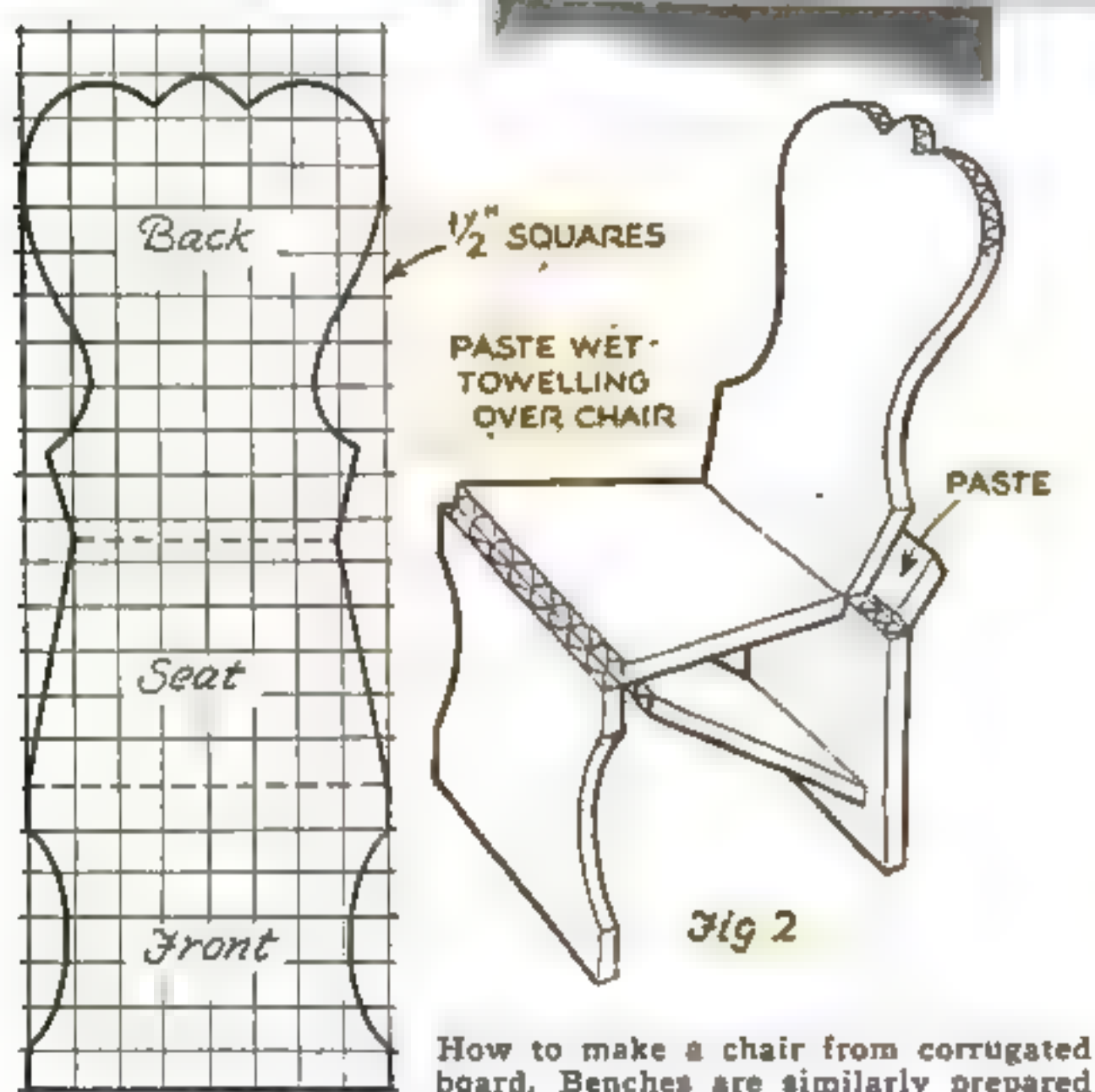
SHORT CUTS IN MAKING

Properties *for*

By
**Florence
Fetherston
Drake**



To enable quick scene changes to be made, it is well to arrange the properties beforehand on boards cut to fit the stage floor, as shown at the left. The drawings above illustrate the method of molding with paper



How to make a chair from corrugated board. Benches are similarly prepared

illustrated were made in this way, the cardboard and paper skeleton being retained. Another idea is to use bowls, trays, bottles, boxes, and the like for the foundation. Jars for an Aladdin setting may be made in this way over jars of appropriate size and shape as shown in Fig. 1 of the drawings.

The moist paper can be made to take the shape of any object upon which it is placed. By laying on other strips of pasted paper, the shape will be retained. It forms a stiff substance like cardboard. When dry, the whole is easily removed from the mold. Should the objects used as a mold be of a shape from which the shell cannot be removed without break-

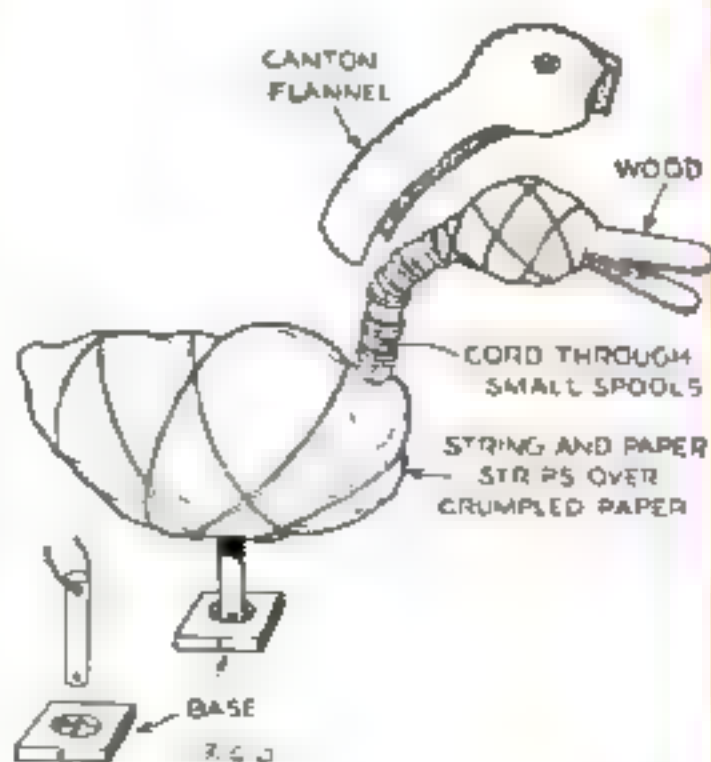
ing, it may be cut where necessary. These cuts should be made when only two or three layers of paper are in place and when the paper is perfectly dry. Lift it from the mold and carefully join the cuts

with pasted paper; then make the shell as thick as necessary, adding perhaps three more layers. To make the jars needed in an Ali Baba scene, for example, you will require a vase of simple shape about 10 in. high for 12- or 15-in. puppets (see Fig. 1). The newspaper is torn into pieces about the size of the thumb joint. Have a pile of white and one of tinted newspaper so they may be pasted on alternately. Turn the vase upside down and cover the bottom first, working down. The first paper layer is applied wet, but not pasted, so that it will not stick to the shell when it has to be removed later, and it should cover the entire form. Now, with the tip of the paste brush, lift a bit of white paper and apply it to the base of the jar, pasting it lightly. Add another piece overlapping the first, and continue until the entire surface is covered. Start again, this time using the colored paper, and cover the entire surface. Be sure the paste goes on the piece of paper already on the jar. Other dry pieces are added and are brushed with paste when in position until three layers have been applied. It should then be set aside to dry thoroughly, after which it is cut in several places and removed from the mold.

FOR making properties for a marionette stage there is nothing better, simpler, or quicker than paper modeling. Anything from a bird to a large dragon, from a teacup to a throne, can be imitated in this material. The cost is nothing, and the tools required are few.

This method can be combined with the paper-pulp process fully described in a previous article in this series (P.S.M., Jan. '36, p. 57). The equipment necessary is two piles of newspaper, one of white and one of colored sheets, a bowl of thin wallpaper or flour paste, another bowl of water, and a soft flat brush large enough to paint the paste on quickly. The advantage of using alternate white and colored paper is that you can determine how many layers have been applied.

Some kind of support is needed for the wet paper while it is being built up. One plan is to build up a rough armature or skeleton of folded paper, metal, or cardboard, which acts as a support for the object being made. Later it can be removed or not, as desired. The chairs and bench



Goose for the circus scene shown at right. The backdrop is white, with strips and disks of bright red muslin sewn on. The clown is able to give a ball-juggling act



Marionette Shows

Several other layers are pasted on; three or four should be enough. When dry, the edges of the jar are trimmed and sand-papered. If a rim is desired, it can be made by using a soft, heavy cord, pasted in position around the top. Finally color with red and brown poster paints to give an Oriental effect. Shellac if you wish, though this is not essential. When using these jars, attach them firmly to a plank or to the floor, or weight them with sand.

Chairs and garden benches may be made of corrugated pasteboard, then covered with three layers of pasted paper toweling and painted (see Fig. 2).

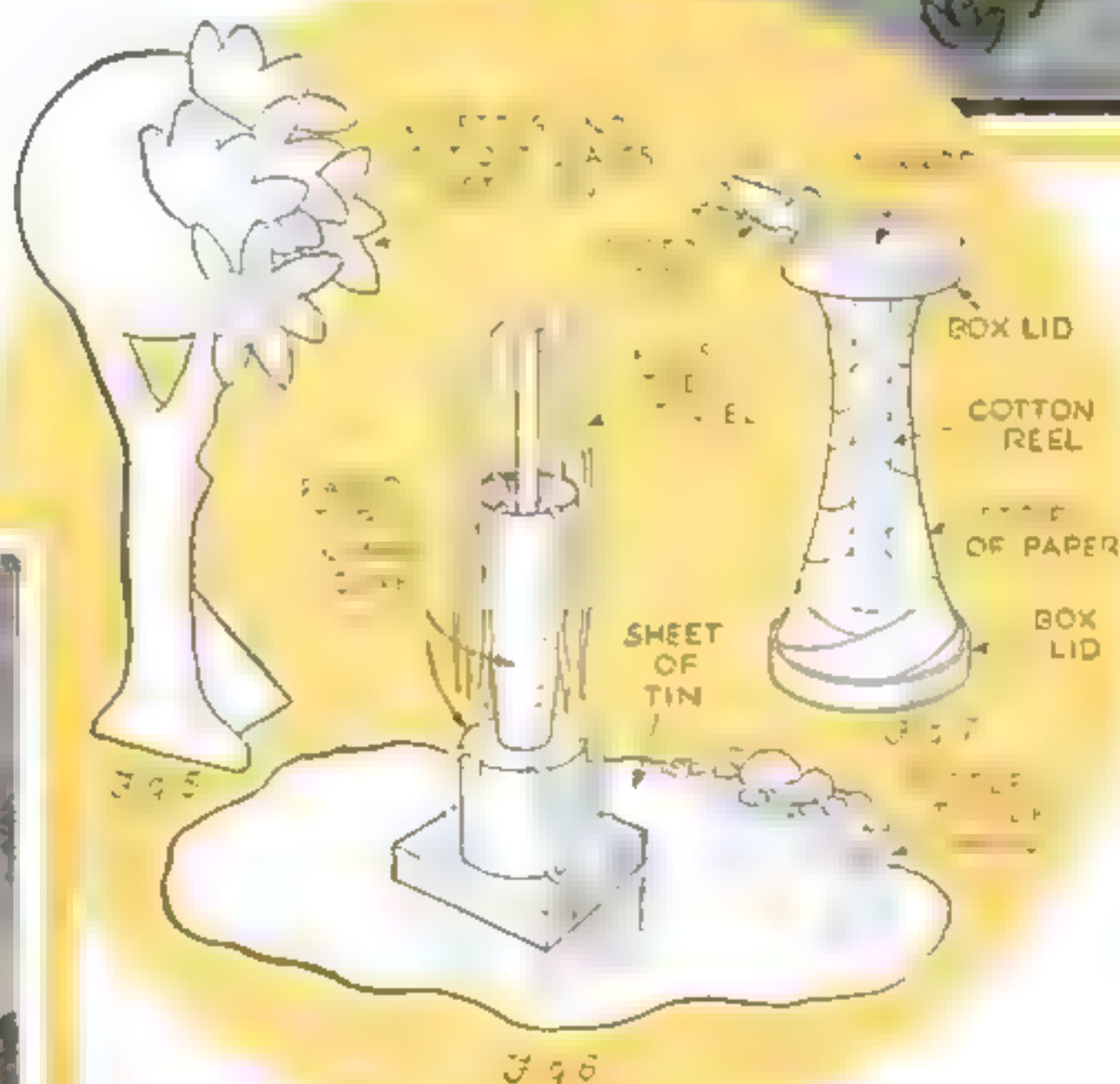
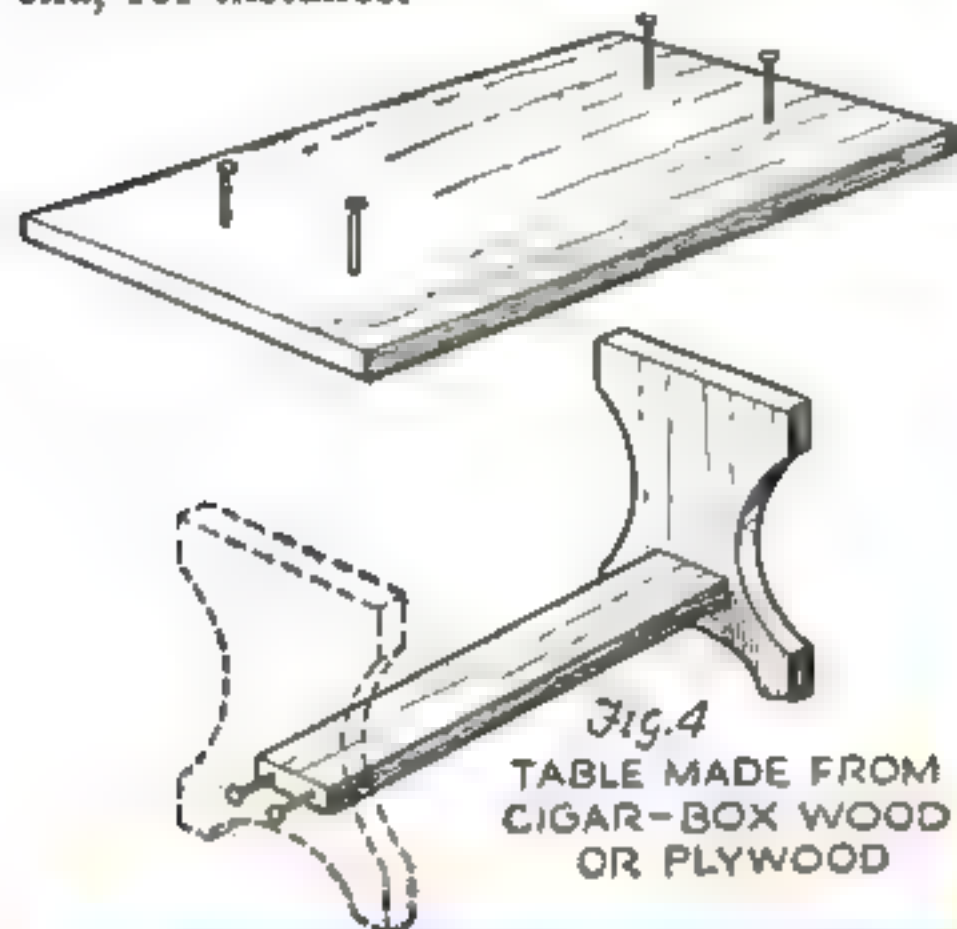
Molds, when needed, may be articles found around the house or shop, pans or plaster forms, or they may be built of clay, wax, or soap. For larger objects, the frames may be made of cigar-box wood. Balls of paper tied together work out well for certain forms—a pumpkin for Cinderella, for instance.

It sometimes happens that small objects should be hollow, in which case bags of sand are used, the sand being emptied when the article is finished.

In making animal heads, full-size drawings should first be made, showing front and side views, as was described in an earlier article on making marionette heads. Paper is then crumpled into the general shape and tied. After binding strips have been pasted on to hold the mass, the paper and then the fabric (usually Canton flannel for animals) is pasted on. The goose in the circus set illustrated in one of the photographs was made in this way. To make the neck flexible, small spools were strung



The trees in this scene are flat disks with green paper pasted on, and the pool is merely a sheet of tin. The bird bath is made of box lids, a reel on which cotton had been wound, and a round mirror



on soft cord and inserted in the throat as in Fig. 3. No paper was pasted here; the Canton flannel over the spools forms the head and neck. Legs are of dowels or wire; web feet and bill of wood colored orange.

Wooden furniture is easily constructed from cigar-box wood, cheese boxes, or thin plywood.

Use a coping or jig saw to cut the curved portions (Fig. 4). Toy furniture from the five-and-ten-cent stores may be used if of the right proportions, but not otherwise.

Actual chair seats are about 17 in. high and table tops 30 in., so if your puppets are 12 in. tall, for example, which is approximately one fifth adult size, these small sets should be scaled accordingly; thus one fifth of 17 is approximately 3½, which should be the height in inches of the chair seat. Sizes of bureaus, fireplaces, book-cases, and other pieces should be calculated likewise. Do not bother with small fractions; keep to the general ratio. When using figured fabrics for curtains or hangings, be sure the design is in scale.

The trees (Continued on page 103)



The trunks of palm trees may be made by wrapping 2-in. wide tan crepe paper around mailing tubes, and the leaves imitated with green paper and wire

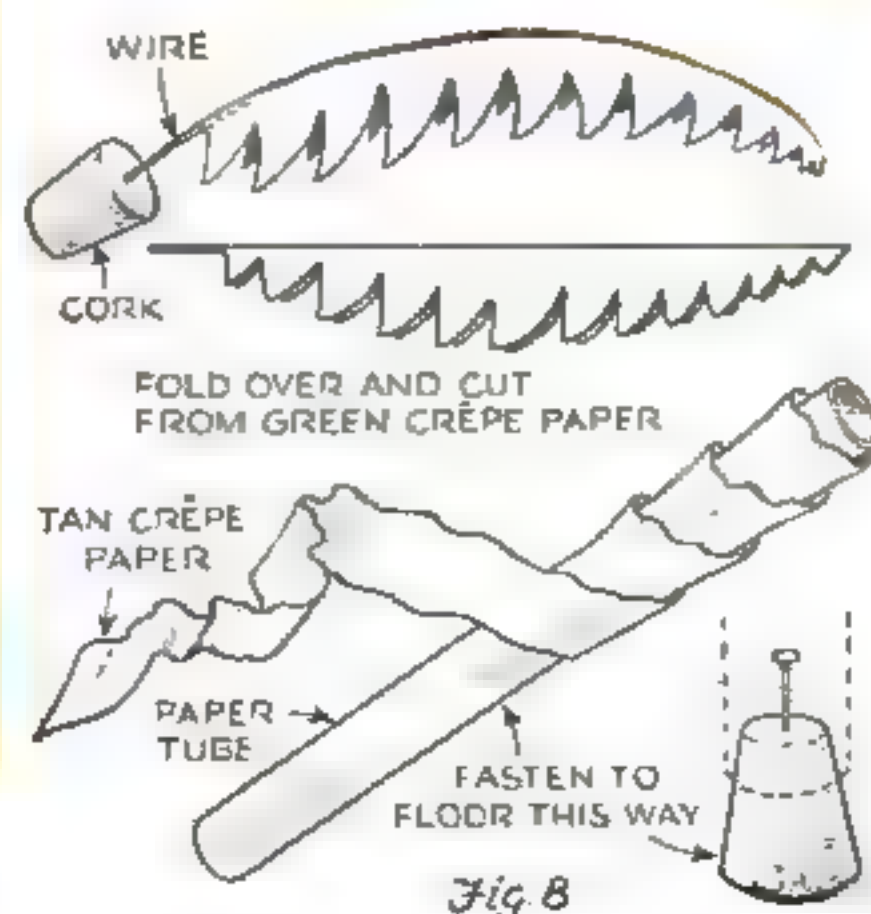
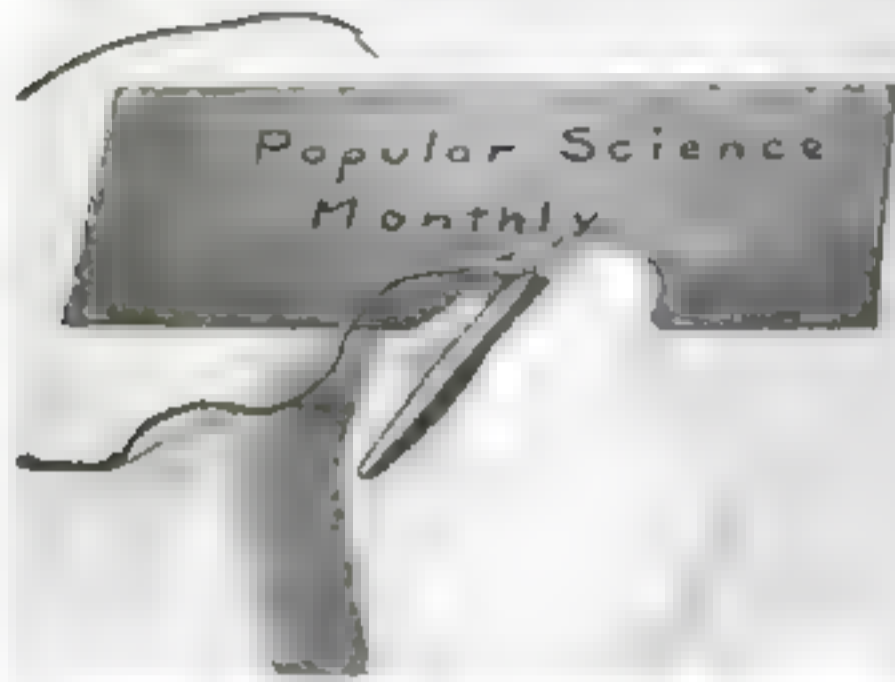


Fig. 8

You Can Write on Metal

with this easily made vibrating electric pencil

By KENDALL FORD



A battery or a small transformer supplies the current required to operate the pencil

TOOLS and other metal objects may be permanently marked for identification with a homemade vibrating electric pencil of the type illustrated. It may be easily made from odds and ends.

The handle is shaped as in Fig. 1 from a piece of close-grained, round wood, $\frac{3}{4}$ in. in diameter and 6 in. long. A piece of maple dowel forms an excellent handle, but if it is not available, a satisfactory substitute may be made from an old broom handle. Drill a $\frac{3}{8}$ -in. hole in the large end of the handle to a depth of $1\frac{1}{8}$ in., and a $5/32$ -in. hole to a further depth of $\frac{1}{8}$ in., as shown. Then cut a recess in one side of the handle for the armature spring.

Obtain a piece of soft iron rod, $5/32$ in. in diameter, and cut to the size and shape indicated in Fig. 9. A 12-penny nail has an approximate diameter of $5/32$ in. and will serve satisfactorily for this piece.

Approximately 6 ft. of No. 20 double cotton-covered wire will be required for the coil.

Place a narrow strip of friction tape along the iron rod, or core, and start the winding $\frac{1}{2}$ in. from the pointed end. The end of the wire is placed over the tape (Fig. 10), after which the end of the tape is folded back over the wire. When the first turn of the coil is completed, it will pass over the folded end of the tape and secure the starting lead firmly in place.

Continue winding until within $\frac{1}{8}$ in. of the opposite end of the core. Then fold over the tape and begin the second layer of the coil. As the second layer is started, place a narrow strip of friction tape on the opposite side of the core and proceed as in winding the first layer. Three layers of wire should be wound on the core, with the ends brought out as shown in Fig. 3. Shellac or paint the coil to serve as a binder.

Obtain a piece of No. 26 gauge spring brass or phosphor bronze, $\frac{1}{4}$ in. wide and $2\frac{3}{4}$ in. long. Mark off sections and drill as shown in Fig. 4. This piece, together with those shown in Figs. 6 and 8, serves as the armature and point holder. Drill all the holes with a No. 40 drill, except where a No. 44 drill is indicated. Shape the spring as shown in Fig. 5. Cut a piece of No. 20 gauge soft iron to the size shown in Fig. 6, drill and thread as indicated, and bend to the shape shown in Fig. 7. Rivet pieces 5 and 7 together with a piece of soft iron wire, as shown in Fig. 3.

A piece of No. 26 gauge soft brass or tin should now be cut to the size shown in Fig. 8. Drill as indicated and bend so as to form a groove for holding the needle or copper point securely to the armature. Secure the needle holder to the end of the armature with a No. 4-40 machine screw.

Insert the coil in the handle and bring the starting lead to a small Fahnestock or battery clip, as shown in Fig. 3. A clip taken from an old radio "B" battery will serve. When securing the clip to the wooden handle, take care that the wood screw does not extend into the coil. The end lead of the coil should be brought out through a small hole previously drilled from the spring recess to the end of the large hole in the handle.

Fasten the armature to the handle with a small wood screw, and solder the end lead of the coil to the screw, as shown in Fig. 3. Glue a piece of tape or thin cardboard over the spring

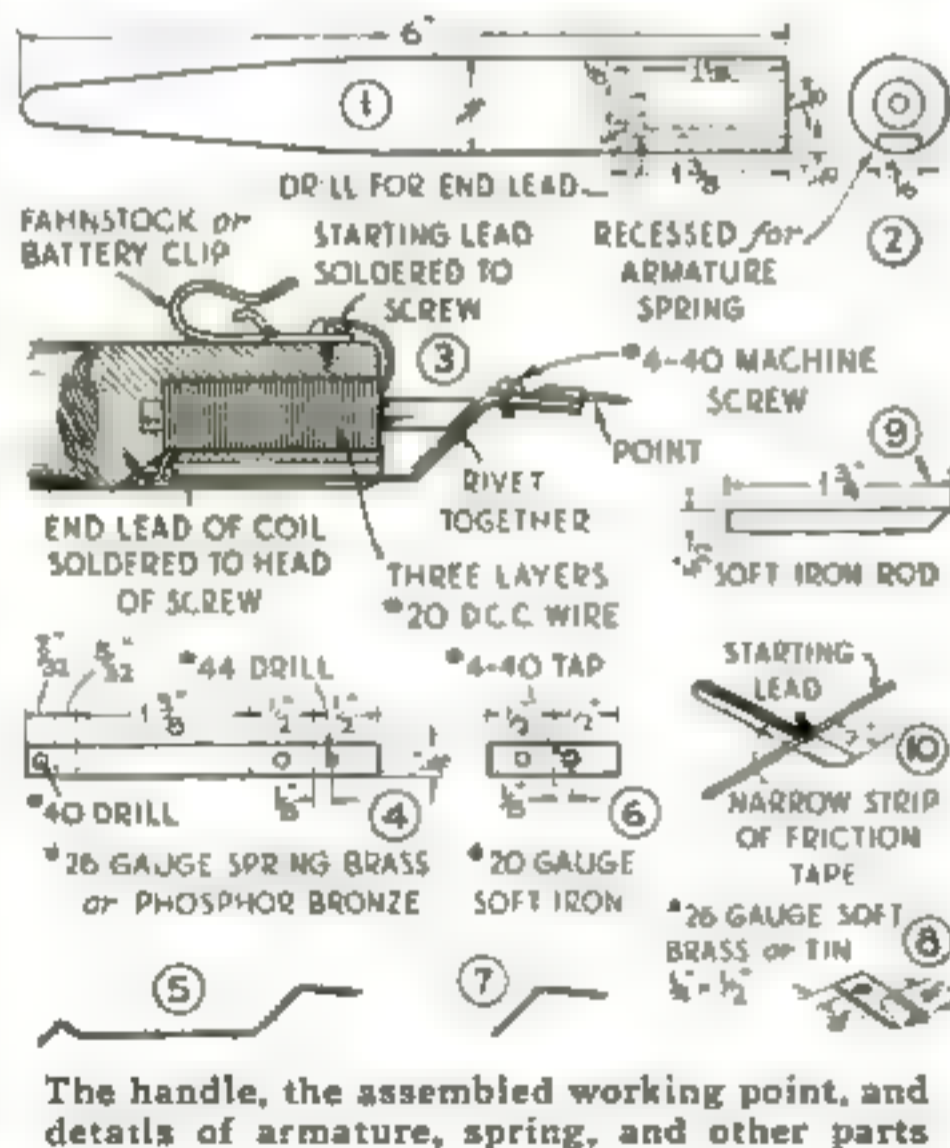
recess, and paint the handle a suitable color.

The point may be an old phonograph needle or a pointed piece of copper wire, but since the effect of each varies on different metals, it is advisable to experiment with both.

In using the pencil, one wire from the source of supply is connected to the article to be marked, and the other wire is connected to the clip on the pencil. From four to six volts will be re-

quired to operate the pencil, and this voltage may be obtained from either a battery or a small transformer. The pressure applied to the pencil should not be so heavy that it will not allow a free movement of the vibrator.

For marking wood, leather, and other soft materials, an electric pen of the pyrographic type is used. How to make such a pen was told in an article by Kenneth Murray last month (P.S.M., Apr. '36, p. 63).



The handle, the assembled working point, and details of armature, spring, and other parts



After the candles have burned down, the ring is lifted entirely away to enable the cake to be cut

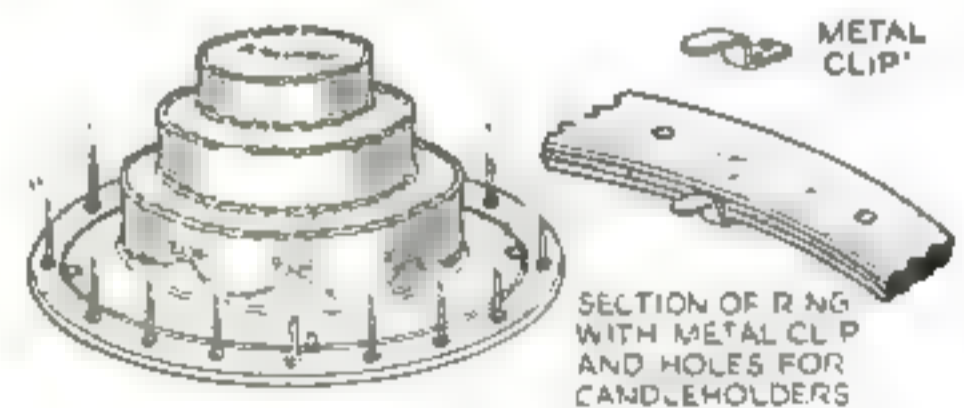
BIRTHDAY CANDLES HELD ON RING AROUND CAKE

NO BIRTHDAY celebration is complete without the cake and candles, yet hardly a birthday ends without a burned or greased tablecloth to vex the hostess. Here, however, is a contrivance that removes this danger.

Cut from $\frac{1}{2}$ -in. plywood an 18-in. disk. Now saw from the disk a 1-in. ring, taking care to maintain full width and to cut true to the line. The edge of the remaining disk should be trimmed to give from $\frac{1}{8}$ to $3/16$ -in. clearance between disk and ring. Bend four small pieces of metal to form projections that will hold the ring a trifle higher than the upper surface of the disk, and nail them lightly to the underside of the ring.

Disk and ring may be painted with high-gloss, quick-drying enamel, varnished in natural wood, or covered with foil or colored paper, and topped with a paper doily. The last arrangement is probably best as the paper can be renewed at each using and can be chosen to fit the color scheme. Drill small holes at regularly spaced intervals around the ring to take the wires that are attached to the usual candleholders.

The cake is placed on the disk, and the ring with candles in place is dropped into place. Bringing on the cake, with candles ablaze, constitutes a colorful climax to the birthday celebration. After the candles have burned down a bit, the ring with its smoking and dripping candles can be lifted clear and carried out bodily to the kitchen. —JACK HAZZARD.



The cake is supported on a plywood disk, and the candles rest on a removable plywood ring

REALISTIC SMOKE FOR MODELS

If you have what model makers refer to as a "live steamer"—that is, a steam-driven model—and want to take realistic photographs of it in action, you can use "dry ice" to give the appearance of billowy smoke. Simply place a little down the stack of the model. If desired, a separate chamber may be provided for the "ice," through which the exhaust steam passes on its way to the stack. "Dry ice" may be obtained at ice-cream plants. —DAVID H. MERRILL.

HOW TO CONSTRUCT A FUN-PROVOKING Cigarette Dispenser

When the fisherman's figure is pushed backward, one of the fishes instantly disgorges a "butt"

By
**HOWARD
R.
HEYDORF**

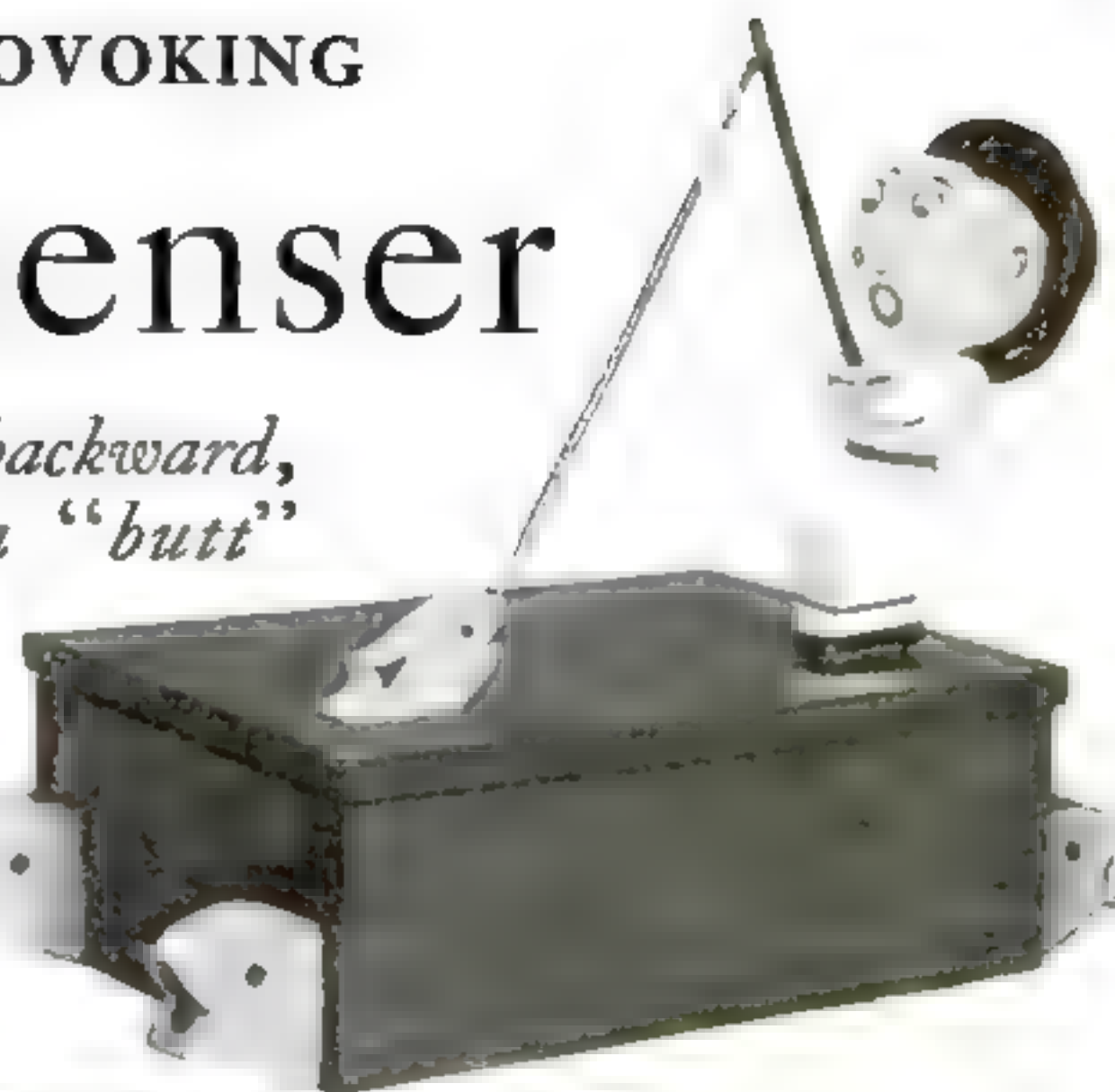
STRUGGLING with his catch, this comic fisherman seems to be fighting a pretty hopeless battle. Give him a little help by tilting him backward and he will reward you with a cigarette delivered through the mouth of one of the fishes. He will continue to deliver cigarettes one at a time till the magazine of thirteen is empty.

Although any kind of wood may be used for making this novelty, hardwood is better for the sides, ends, and top of the box. Softwood, preferably white pine, is used for the figures and the ejector, as it is easy to work.

The ends and sides of the box (see the drawings near the end of the article) are constructed of $\frac{1}{2}$ by $2\frac{3}{8}$ -in. stock, the sides being 7 $\frac{1}{2}$ in. long and the ends 4 $\frac{3}{4}$ in. The corner joints are cut as shown. When these pieces are fitted together, the outside measurements should be 7 $\frac{1}{2}$ by 5 $\frac{1}{4}$ in. A groove $\frac{3}{16}$ in. wide and $\frac{1}{4}$ in. deep is cut at an angle in the end pieces to take the bottom piece, which is of $\frac{3}{16}$ -in. plywood 7 in. long. The width is cut to fit, and the edges are beveled to meet the sides of the box. The box is not glued till later.

The top is of $\frac{1}{2}$ -in. stock, 7 $\frac{1}{2}$ by 5 $\frac{1}{4}$ in. A rabbet $\frac{3}{16}$ in. deep and $\frac{1}{2}$ in. wide is cut around the underside of the block, and the two small openings shown are cut out with the scroll saw. The head of the fisherman is made on the lathe, the hat, head, and nose being turned in one piece. It should be sanded to a smooth finish. The figure should be drawn on $\frac{1}{2}$ -in. wood and scroll-sawed to shape. A $\frac{3}{16}$ -in. metal dowel joins the head and body. A $\frac{1}{4}$ -in. wide groove is cut in the bottom of the figure to take the pivot piece. The latter is of $\frac{1}{4}$ -in. stock shaped as in the drawing to fit the hole in the top of the box. The fisherman and the pivot piece should be drilled for the pivot, which is a small brad. A $\frac{1}{8}$ -in. hole should be drilled for
(Continued on page 95)

Loading the magazine with cigarettes so arranged that they roll down automatically into place for ejection

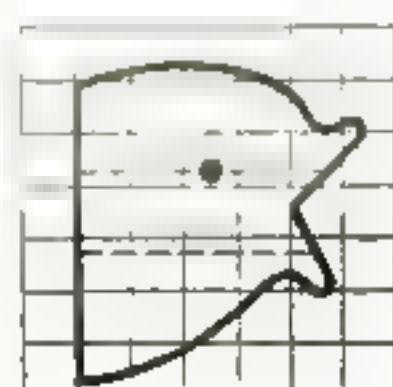
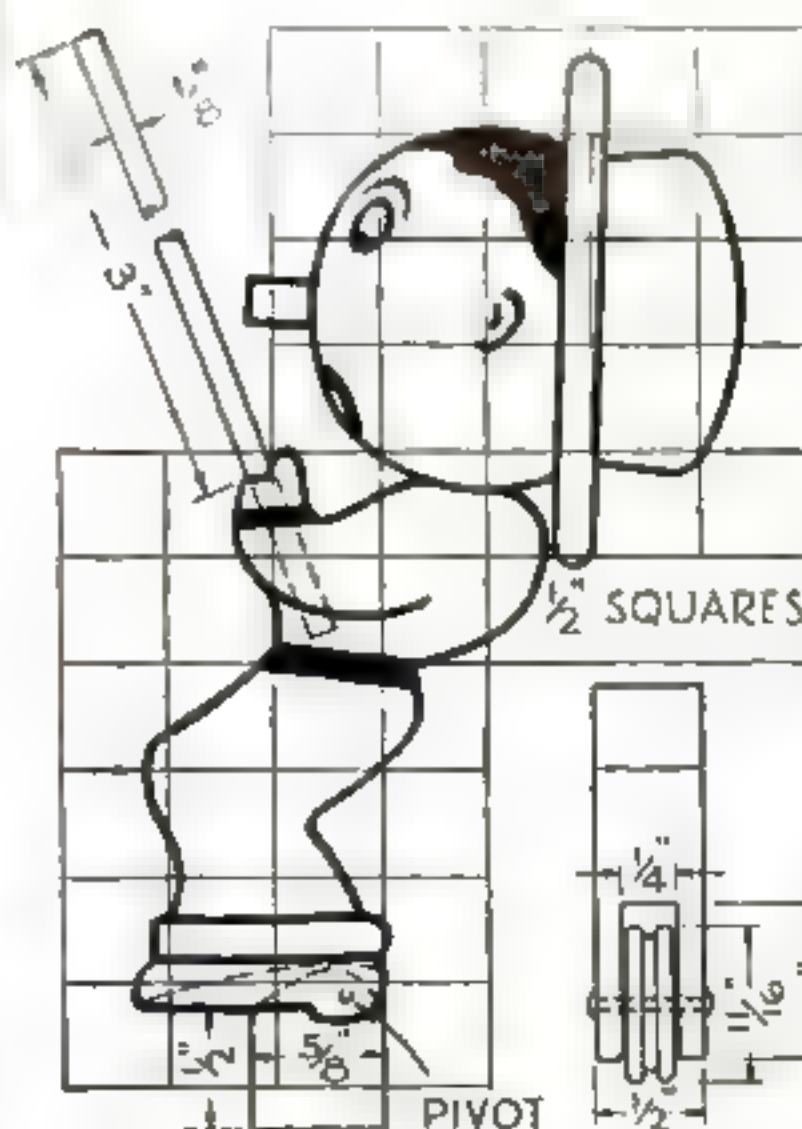


Below is shown the underside of the top and one side with the ejector mechanism

The fisherman is perpetually about to catch a fish. When he is given a helping hand as at the left, a cigarette is pushed out of one of the four fish heads which decorate the lower corners of the box.



The interior of the box with slanting bottom, dividing piece, guide, and slide. The guide is being tested to see that it works smoothly. Note stretched rubber band



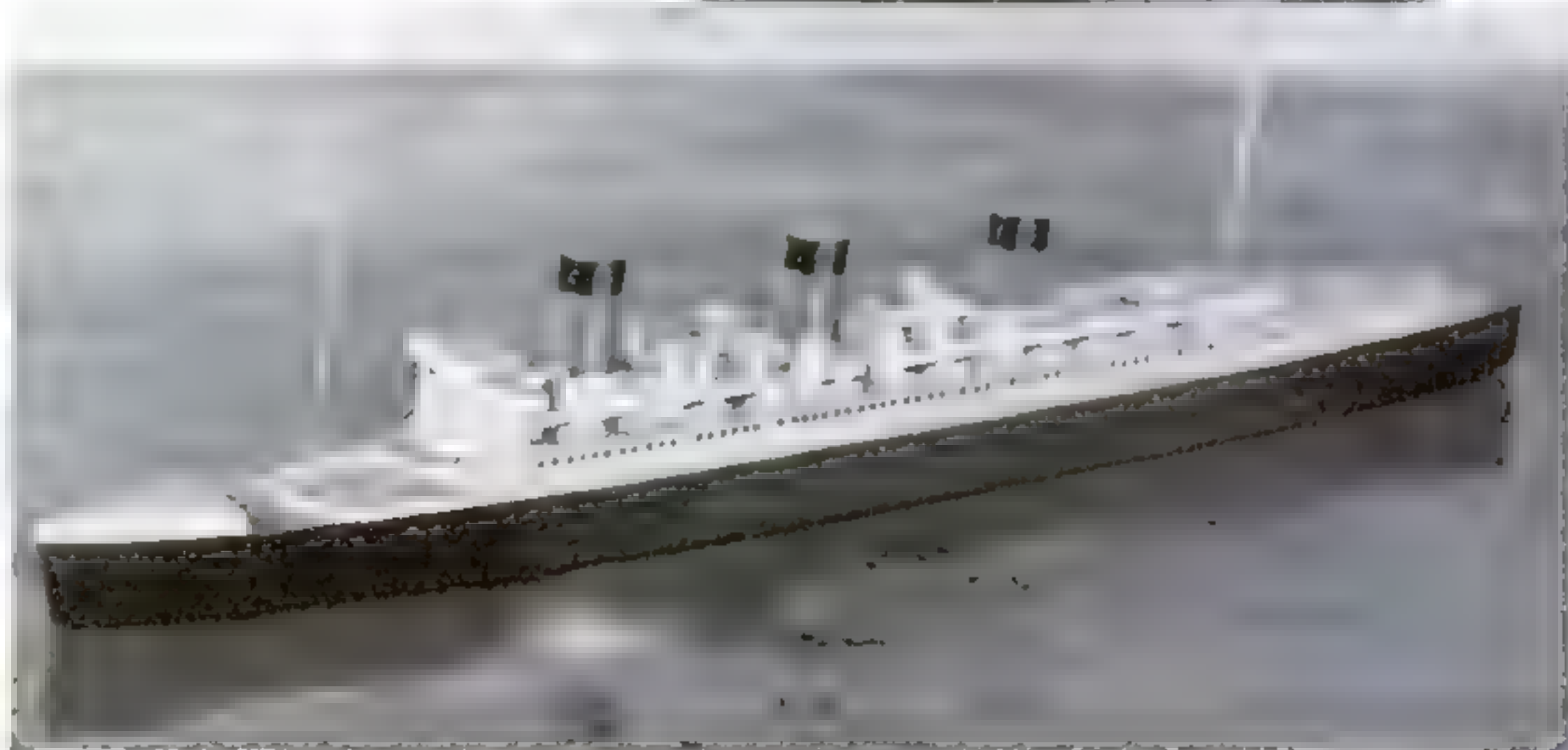
FISH HEAD
($\frac{1}{4}$ " SQUARES)
DETAILS of FISH
and PULLEY



The fisherman, side and front views of the fish and pulley, and pattern for the fish heads, with squares for enlarging

Miniature Model

By *Theodore Gommi*



Bow view of the trim little model. It is 10¼ in. long

The simplest possible method of construction has been followed. It is similar to that used in many of the preceding projects in this series in that all parts of the superstructure are cut from thin wood and built up, layer on layer. Even those who have never attempted to make a model

Cut all wood to the sizes specified. You will notice in the list of materials that a number of pieces—all those marked with an asterisk(*)—will be ready for the final assembly when cut to the dimensions specified. The remainder should be shaped to conform with the outlines given in the drawings.

(Continued on page 86)



Simplified Alphabet for Jig-Sawing MODERN WINDOW SIGNS



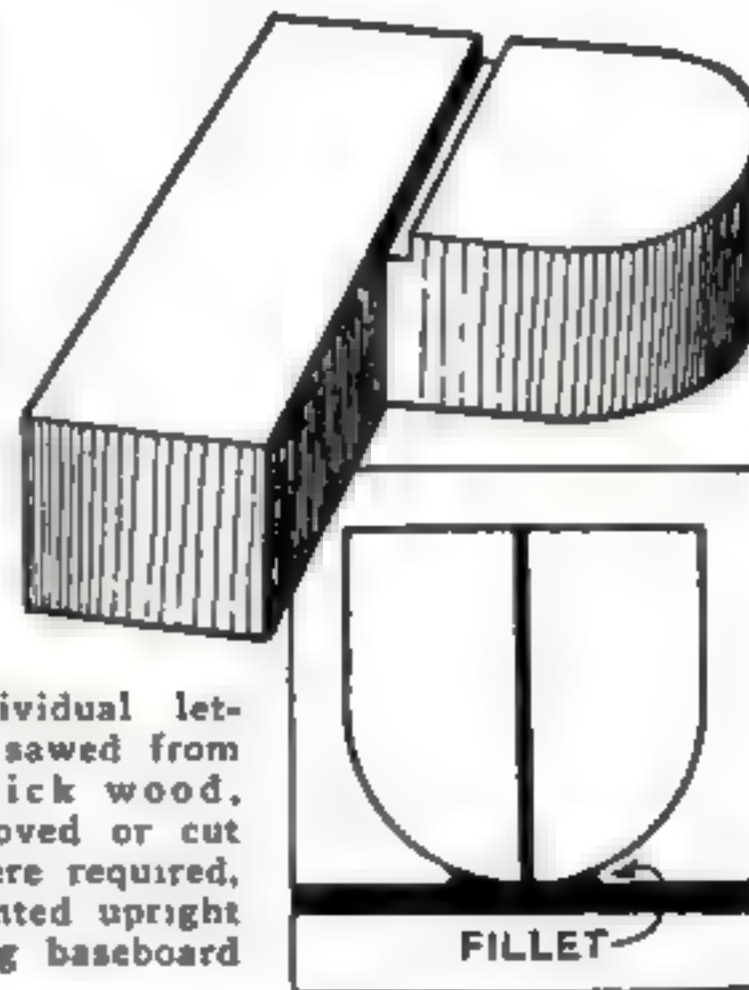
SHOWN in the photograph above is a sign made by the author for use in the window of a smart shop in Palm Springs, Calif. It has earned so much favorable comment that the method and special alphabet are offered here for the pleasure and profit of other homeworkshop enthusiasts.

Signs of this kind are easily made with a band, jig, or coping saw and a few other tools found in any shop. A piece of lumber 1 in. thick of sufficient size will be necessary. White pine is suitable because it is so soft and easily worked.

Lay out the necessary letters on the board, following the proportions shown in the drawings as closely as possible. The dimensions marked X will be determined in each case by the size of your letter. For example, if you want the letter A to be 4 in. high, then X equals 4 in. The other dimension shown would then be $1\frac{1}{8}$ times X , or $1\frac{1}{8}$ times 4, which equals $4\frac{1}{2}$ in. The letter A will therefore be 4 in. high by $4\frac{1}{2}$ in. wide. Where no dimensions are shown, the letters are square.

On such letters as O and U it will be necessary to leave a fillet at the bottom,

The individual letters are sawed from 1-in. thick wood, then grooved or cut back where required, and mounted upright on a long baseboard



as in one of the detail drawings above. This makes possible the use of a straight line at bottom, and enables the letters to be mounted on the base to be described later. Letters like E and F also require fillets for strength.

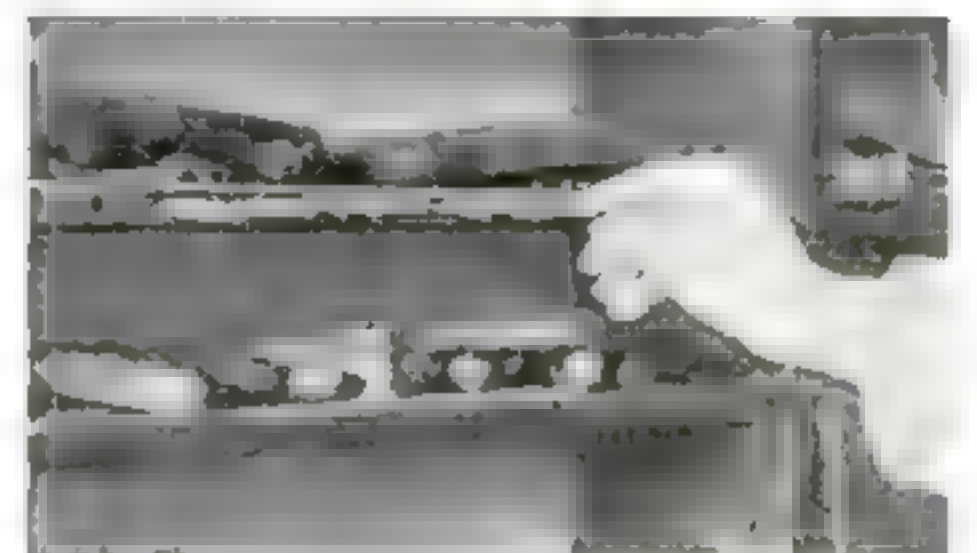
Check the layout and if it is correct, saw out the letters, keeping the edges as true as possible. The black portions shown in the drawings represent the cut-backs, or parts cut down from the actual faces of the letters to a depth of about $\frac{1}{8}$ in. In making these cut-backs, use a sharp knife and a straightedge. Clean out these cuts with a small chisel and smooth the resultant grooves with the edge of a flat file. After these operations, the faces of the letters should stand out in bold relief. Sandpaper them carefully.

Now assemble the letters as they will appear in the finished sign in order to de-

termine the proper length for the base, which should be 3 in. wide, 1 in. thick, and extend 1 in. beyond each end of the assembly. Cut the base and bevel the top edges. Mount the letters with glue and brads, or screws driven up from the bottom of the base. If preferred, the letters and base may be sawed from one solid piece of wood.

After mounting the letters, one or two coats of shellac will prepare the work for painting. When the shellac is dry, coat all parts except the faces of the letters with flat black paint. After this, in turn, has dried, paint the faces of the letters either gold or aluminum.—JOHN F. REYNOLDS.

RACK FOR PUNCHES MADE BY BORING INTO SHELF



WHERE wooden shelves are used over the workbench, a series of small holes may be bored into the edge of the shelving on a slight downward slant to hold punches, nail sets, and various small round tools. It is then easy to select the tool wanted without delay.—JOSEPH C. COYLE.

REMOVABLE BRUSH WIPER SNAPS ON PAINT CAN

A WIRE bent as shown in the accompanying illustration and placed on a paint or varnish can enables one to remove surplus paint or varnish from the brush without spattering it or letting it run down the outside of the can, as is often the case when the brush is cleaned on the top edge of the container. This device, which may be easily removed from one can and placed on another of the same size, is especially valuable where inside work is being done.—I. M. HOWARD.



WHEN using chalk for layout work, try mixing it with alcohol instead of water. It dries more rapidly. For coating finished surfaces preparatory to scribing layout lines, mimeograph ink may be used instead of copper sulphate solution, the fumes of which are likely to rust your tools.



Modern alphabet for jig-sawing. After deciding the height of the letters, lay out the widths. Where no special width is indicated, make the letters square. The heavy lines represent grooves

EASILY MADE Film-Drying Box

Saves Photographer's Time



Photographic negatives are dried in a few minutes in this homemade box. It can be arranged to hold any type of film or plate



An inexpensive electric fan is stripped of nonessentials and installed in the box. Note the crosspieces soldered to the box corners. The heater unit is assembled as shown at the left

By VERNON B. CASE

QUICK drying of photographic films results in better negatives and a decided saving of time in rush work. Miniature camera owners who dry their films in a blast of dustless, heated air will find that the negatives have a finer grain, thereby permitting greater enlargement. The device to be described was designed for drying 35-millimeter motion picture film strips used in a miniature camera. By arranging suitable holders, it can be used as well for plates, cut films, and roll films of any amateur size.

The dryer consists essentially of a box housing a film reel, a fan, a resistance unit for heating the air electrically, and a filter for removing dust particles. The cost of the complete dryer was not more than five dollars. When in operation, it consumes about 275 watts of current an hour.

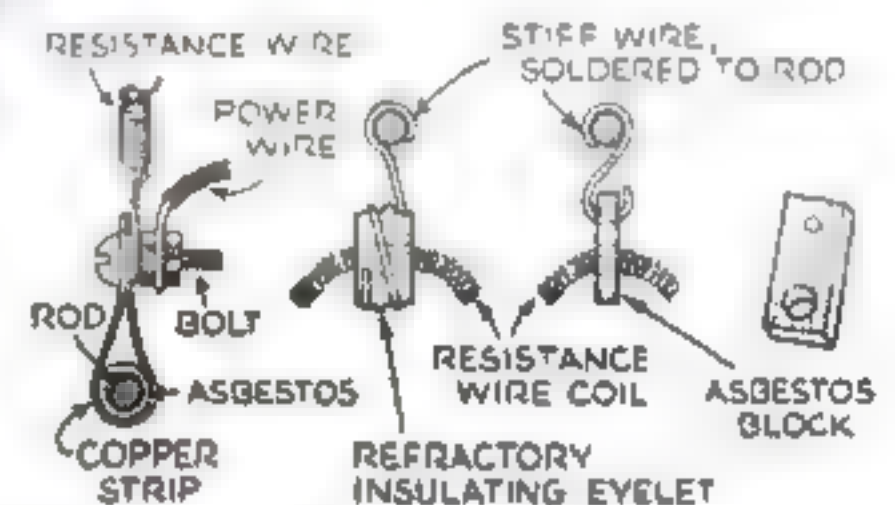
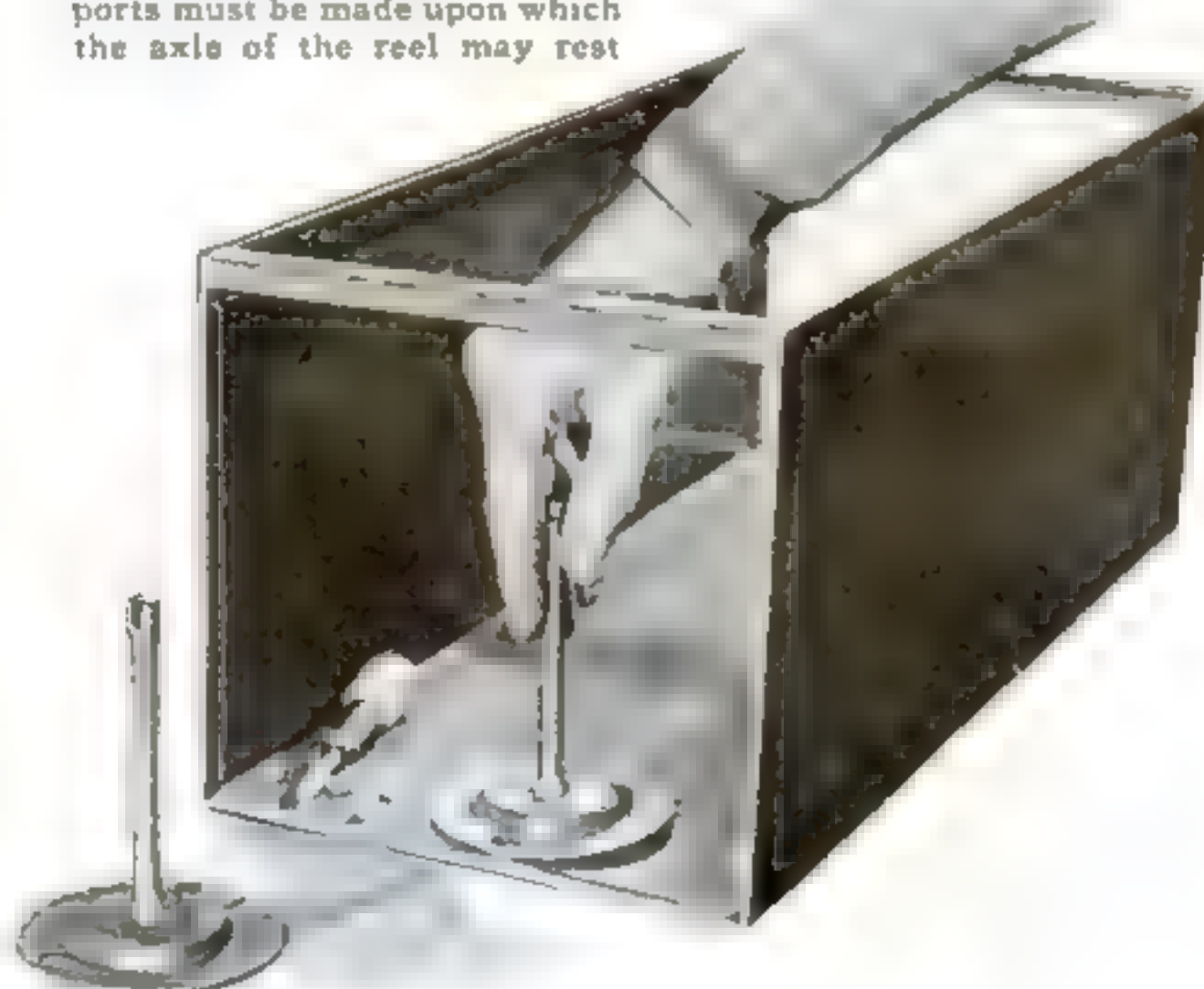
The cabinet is an open-end box $8\frac{1}{2}$ by $8\frac{1}{2}$ by 20 in. with a hinged top. Any tinner can make it, and galvanized sheet iron is suitable. The exposed edges are bent completely over about $\frac{1}{4}$ in., with the exception of the rear top edge where the hinge is fastened, which is bent over about $\frac{3}{4}$ in. Soldered or brazed cross-pieces connect the upper corners. The rear edge of the lid is bent over $\frac{3}{4}$ in., and the remaining edges have a $\frac{1}{2}$ -in. rim made by bending the metal at right angles. Use a piano hinge to attach the lid, and equip the box with a trunk-lid fastener to hold the lid in place.

Obtain a cheap induction-motor electric fan having an 8-in. blade. By cutting away

part of the wire guard and removing the base, you can squeeze the fan into the box. Make lugs from wire or sheet metal, and solder or braze them to the guard, so that they can be held by bolts passing through the front, back, and bottom of the box. Three such bolts are sufficient. The distance from the nearer end of the box to the plane in which the fan blade rotates is about $3\frac{1}{2}$ in.

Immediately in front of the fan, about $1\frac{1}{4}$ in. from the guard, mount the heating unit. To make this unit, obtain about 3 ft. of $\frac{3}{16}$ -in. brass rod, five or seven

If strips of motion-picture film are to be dried, two supports must be made upon which the axle of the reel may rest



The connections for the heating element, and two methods of supporting the coil

refractory insulating buttons or eyelets like those used on electric stoves, and two 550-watt coiled resistance elements of the type used in toasters and other heating equipment. Miscellaneous bolts, copper strips, and the like will also be needed. If you cannot get the insulating eyelets, use small asbestos blocks with holes drilled in them, or some similar arrangement.

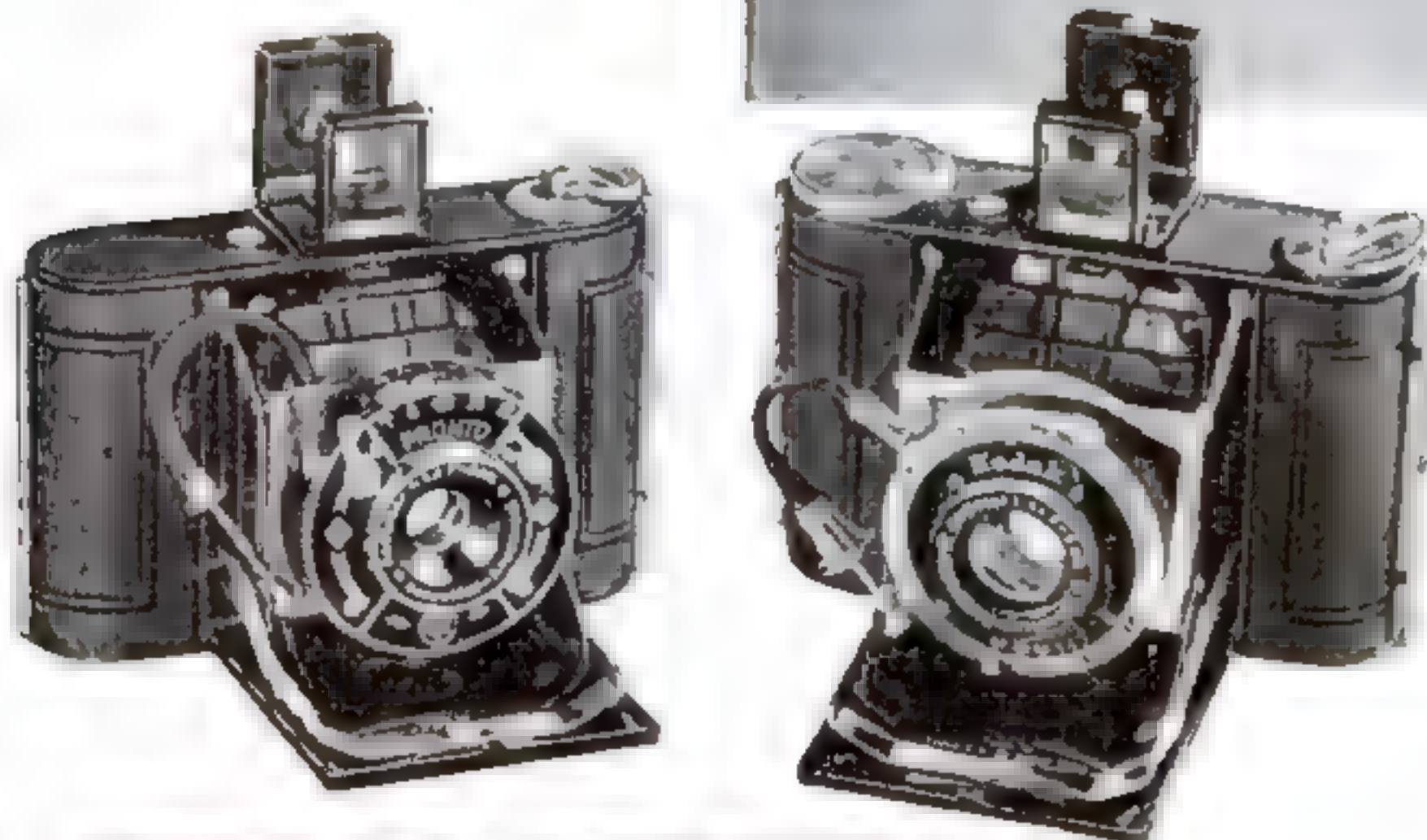
Connect the resistance elements in series by brazing or bolting two ends together. Then run them in zigzag fashion from one insulator to the other, inside the frame. Attach the ends to connection strips at the bottom. These strips are anchored by bolting them around a sleeve of sheet asbestos encircling the lower horizontal part of the brass-rod frame. Iron washers brazed or soldered to the upright portions of the frame are used for bolting the heating unit in place.

Mount two toggle switches, one above the other, in the front panel of the box, between the fan and heater unit. Obtain switches that will carry at least 3 amperes at 110 volts. They are connected, as indicated by the wiring diagram near the end of this article, so that one controls the fan and the other the heating element, but so that it is impossible to turn on the heat when the fan is not running. This is to prevent possible damage to the film.

The end of the *(Continued on page 100)*

For Action...

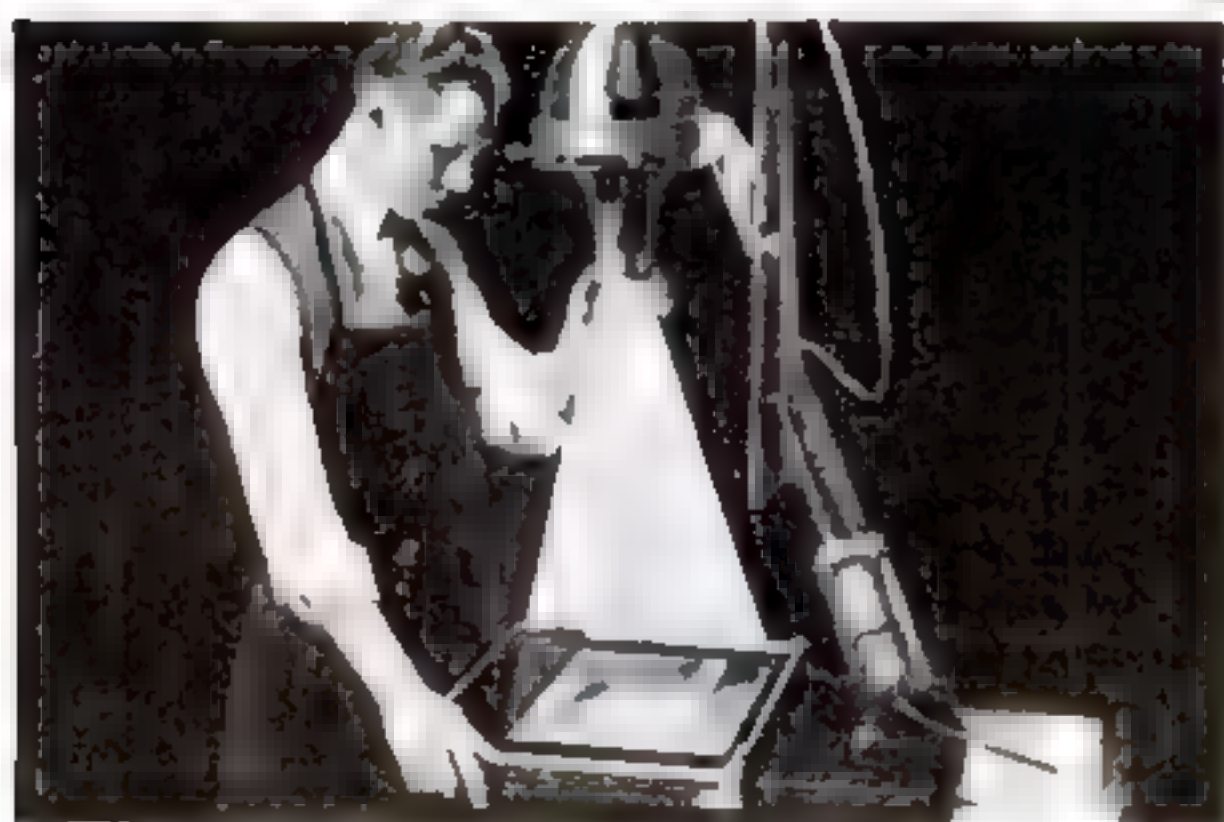
KODAK VOLLENDAA a precision miniature



2 MODELS TO CHOOSE FROM

Kodak Volleenda is a fine miniature camera—at an inexpensive price. Small—it fits in the palm of your hand, pops open for instant use at the touch of a button . . . Precise—it yields needle-sharp negatives that make beautiful enlargements. Makes sixteen 1-3/16 x 1-9/16-inch pictures each loading.

Available in two lens-and-shutter combinations. With 1/500-second Compur-Rapid shutter and f.3.5 lens—\$44.50 . . . with 1/100-second Pronto shutter and f.4.5 lens—\$25.



KODAK MINIATURE ENLARGER . . . With a Kodak Miniature Enlarger to supplement your tiny camera, you get the full fun out of miniature photography . . . prints of astounding size from little negatives. Paper cabinet base optional equipment. Price for enlarger, paper holder, Anastigmat f.4.5 lens—\$67.50. Paper cabinet base, \$10 extra.

KODAK PANATOMIC FILM . . . extremely fine-grained and fully color-sensitive. Especially designed for miniature camera use—an ideal film for Kodak Volleenda and other small cameras. This film makes striking enlargements possible with a minimum of grain.



AT YOUR DEALER'S

Every picture maker should have this book—"How to Make Good Pictures." Its 224 pages are packed with useful photo knowledge. Tells new ways to use your camera . . . how to make trick pictures. Get your copy today.



FREE BOOKLET . . .

you'll want this booklet for your photo library. It gives complete information about all Kodak miniature cameras and equipment. Write for your copy today . . . Eastman Kodak Company, Rochester, N. Y.

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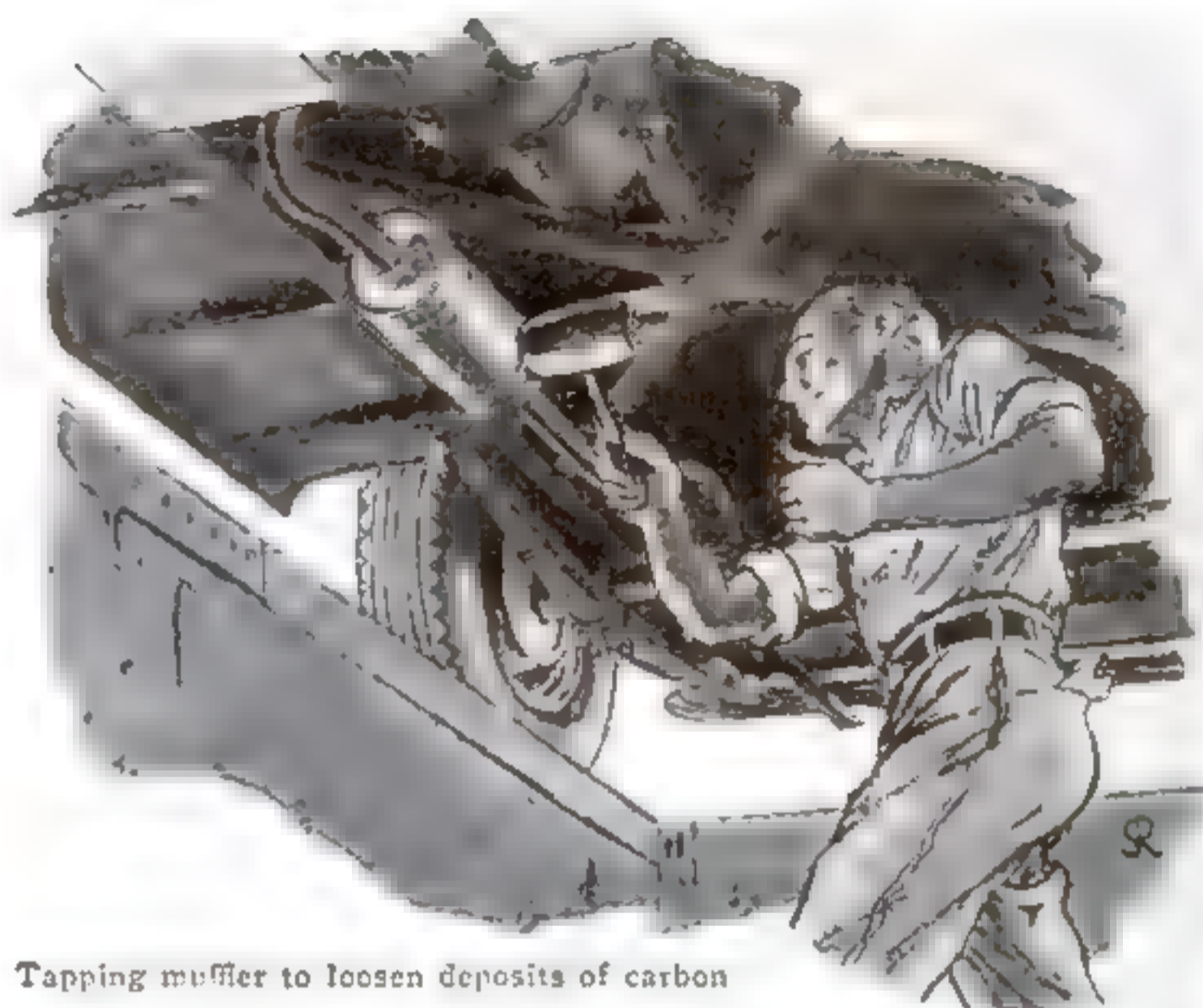
Short Cuts for Car Owners

*Our Readers Pass Along Six Kinks
That Have Helped Them To Keep
Their Automobiles in Condition*

CLEANING OUT MUFFLERS

AN EXHAUST muffler that is badly clogged or stopped up with carbon may cause power losses due to increased back pressure. After long service, the inner surfaces of the muffler become coated with deposits of carbon. These deposits can be loosened, to be later blown out through the tail pipe by

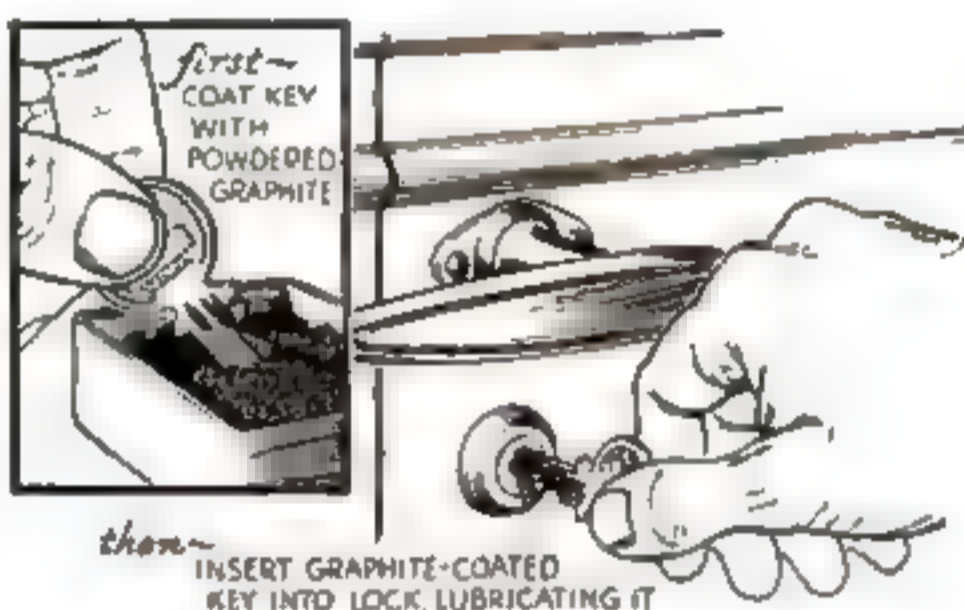
the force of the exhaust, by tapping the muffler with a mallet or a soft piece of wood. Strike sharp blows, but take care not to damage the outer jacket. When the tapping process is completed, start the engine and race the motor, accelerating it in short blasts to clean the system of the loosened particles.—E. N.



Tapping muffler to loosen deposits of carbon

GRAPHITE LUBRICATES CYLINDER LOCKS

CYLINDER locks, like all assemblies of moving parts, require some form of lubrication. This is particularly true of the locks used on car doors, spare tires, and rumble seats. Powdered graphite provides ideal lubrication since it will not gum nor collect dust. Simply dip the key into a small quantity of graphite and then insert it in the lock. Repeat the process several times.—J. N.

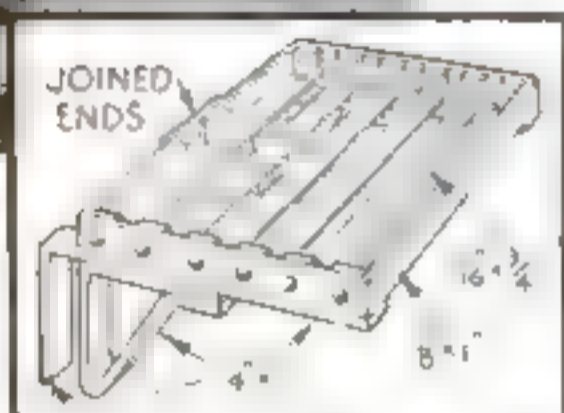


The way to lubricate a door lock pictured above can be applied to any cylinder lock

LUGGAGE CARRIER FITS ON BUMPER



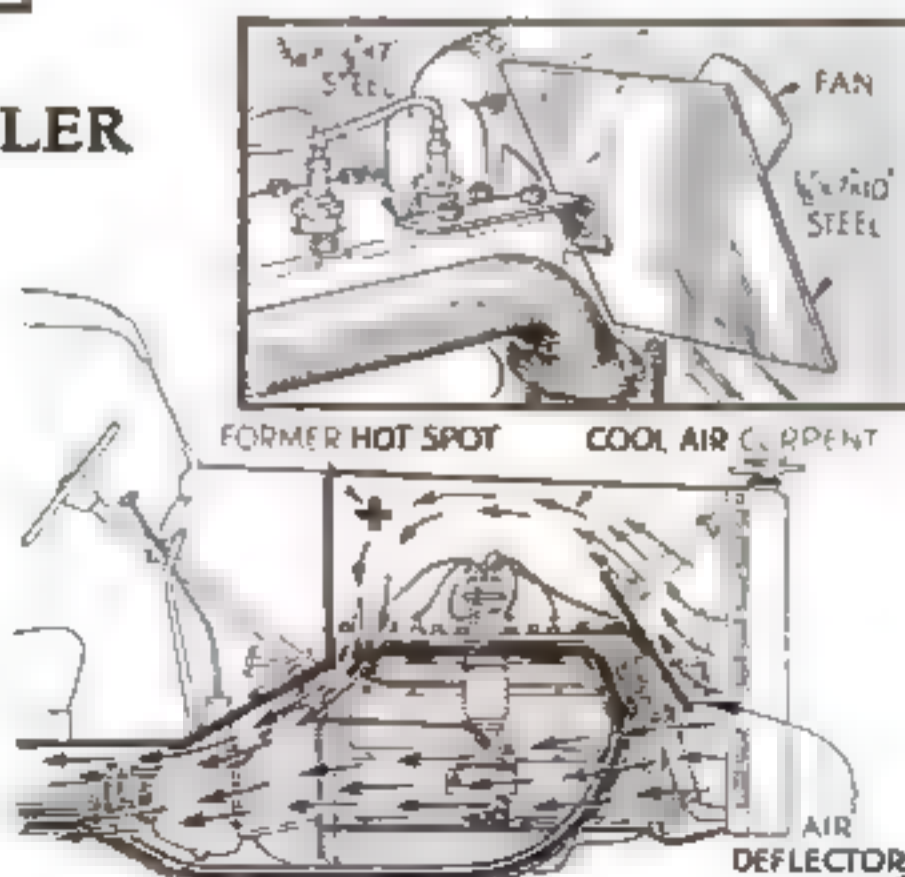
A handy carrying rack attached to the front bumper. It is made of scrap iron, after the plan shown in diagram



For carrying ice, suitcases, fishing tackle, and odd bundles, the auxiliary luggage rack shown has proved particularly useful. Made from scrap iron and assembled with stove bolts and rivets, it simply slips over the center section of the front bumper. Since no mounting bolts or other fastenings are required, the rack can be put in place or removed easily and quickly. When not in use it can be stored in the garage or strapped to the spare tire where it will be handy for use on short errands. Sample dimensions for a carrier that will fit the average small car are indicated in the drawing at the left.—E. S.

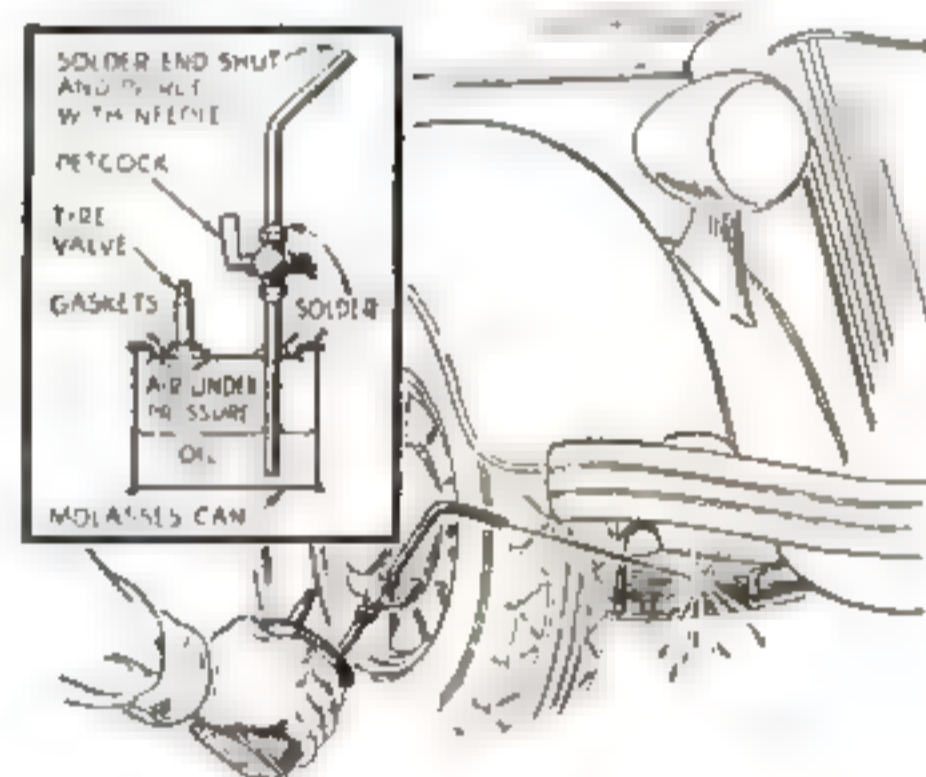
COWL AND FOOTBOARD COOLER

SUMMER driving can be made more pleasant by installing a wind deflector on the motor block of your car to increase circulation and drive out hot-air pockets. The deflector consists of a square of sheet iron mounted at an angle of forty-five degrees just in front of the exhaust manifold. The first two cylinder-head bolts can be used to hold it in place. The air then will be shunted upward as indicated by the arrows in the drawing, directing a strong circulation of cool air against the floor boards.—W. W. B.



HANDY SPRING SPRAYER

FROM a tin can, a valve stem, some copper tubing, and a petcock you can assemble the handy spring sprayer illustrated. Several strokes of a hand pump will build up enough pressure to send a stream of old crankcase oil to any point on the chassis, without "getting under."—G. S. S.



An easy-to-assemble sprayer for chassis lubrication. Its pressure is built up by a hand pump



GARAGE PARKING GUIDE

IF YOUR garage is small, a telltale similar to the one shown will help you to drive your car in just far enough to clear the doors. It consists simply of an old tennis ball suspended on a string from the ceiling at a point directly over the front of the radiator cap when the car is in position. When parking, the car is simply driven in until the ball touches the cap.—J. R.



has rebuilt the old art of making steel around the newer art of making automobiles

AMONG automobile manufacturers, only the Ford Motor Company can produce its own steels. Its complete steel plant can supply all of the many steels required for Ford cars and trucks up to 3000 units of the daily total production.

This does more than provide Ford with large quantities of fine

steels at cost. It guarantees absolute control of quality at every point by men who know both steel and automobiles.

A total of 52 different steels are used in the manufacture of a Ford V-8. Of these, 36 go into the car itself and 16 form tools or equipment used in making the car.

Few industrial organizations in the world hold steel to such fine limits and rigorous specifications as the Rouge plant.

Ford metallurgists maintain close supervision over every type of steel produced, subjecting it to constant tests for chemical content, strength, and workability. They work unceasingly to improve the parts that go into Ford cars and trucks.

Such methods save time, reduce costs. These exclusive manufacturing advantages are important reasons for the high quality of Ford cars and trucks. And they are equally important reasons why you should insist upon Genuine Ford Parts when repairing or servicing your Ford.

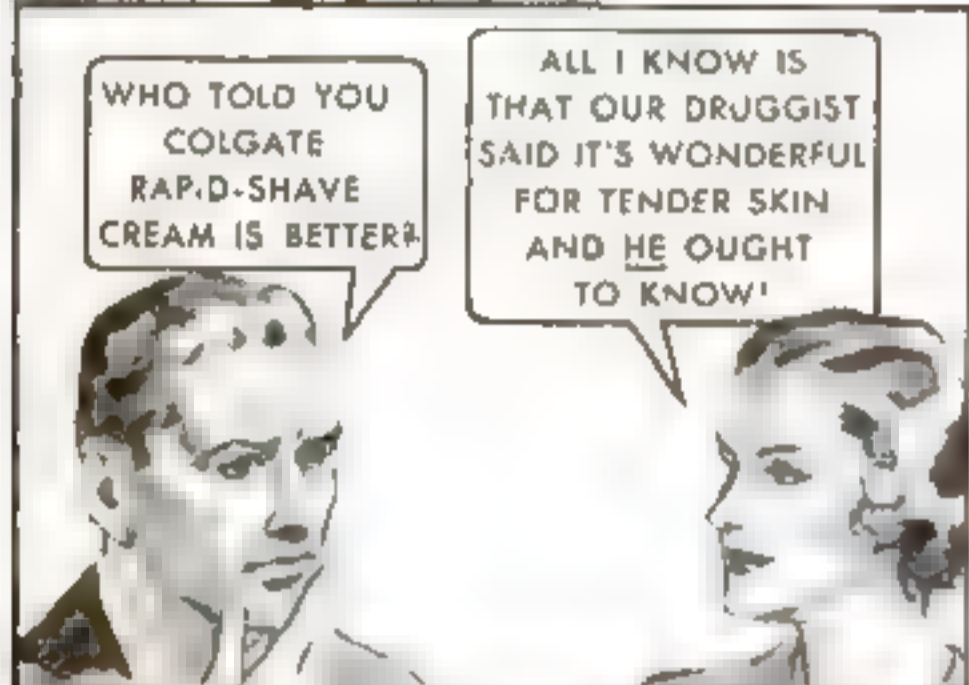
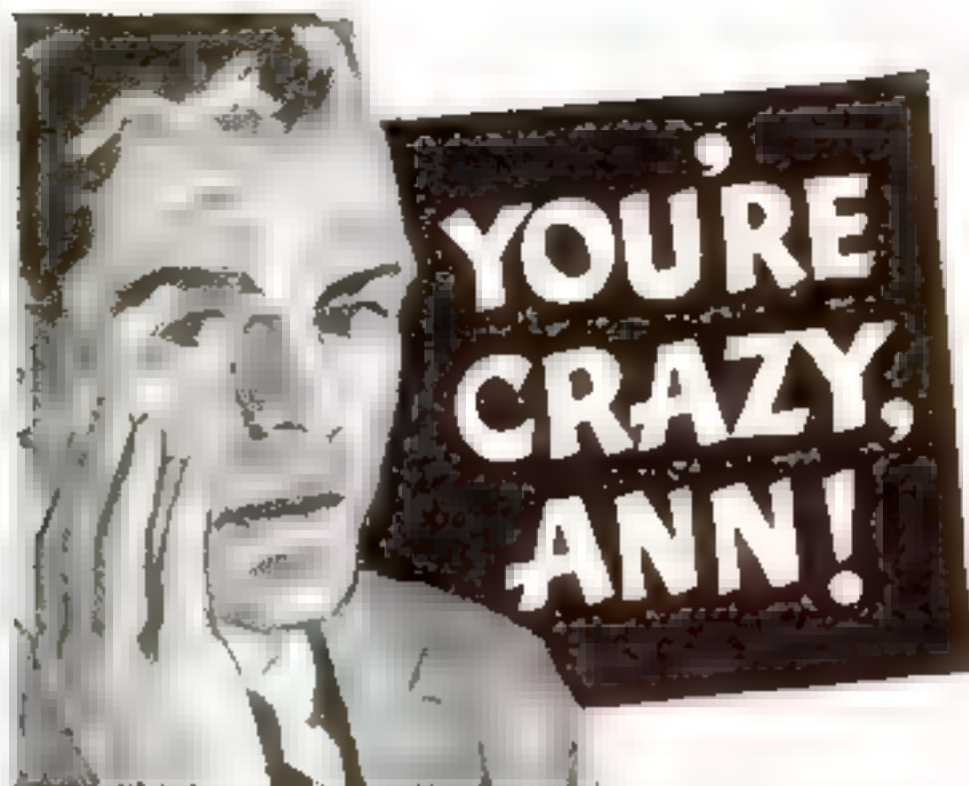


The completion of the Ford V-8 crankshaft is one of the longest tasks in building the V-8 engine. Every completed crankshaft is tested in this "dynamic balance tester."

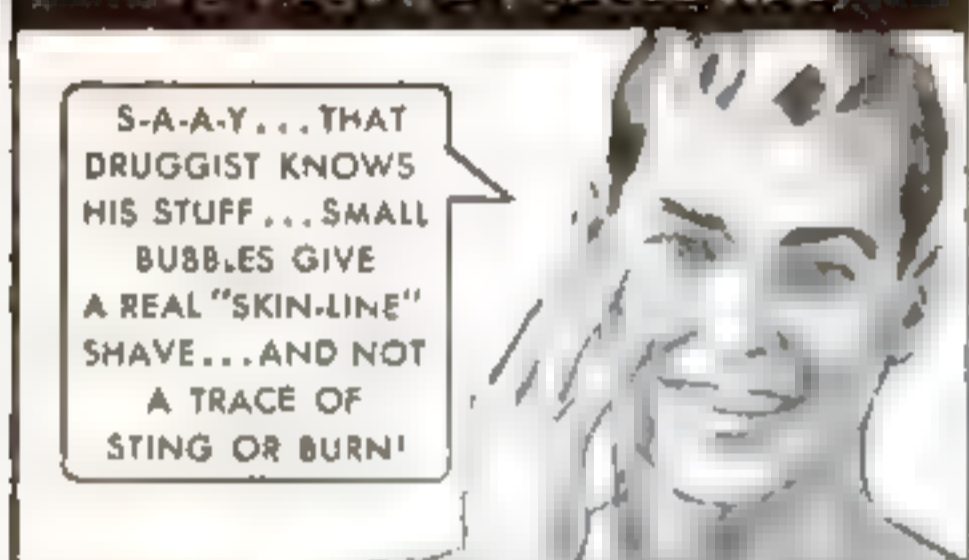


Huge jaws of gigantic presses shape Ford parts from hot metal in a single operation. Front axle ends and blanks for pinion gears are formed in such presses.

F O R D M O T O R C O M P A N Y



SO JUST TO PLEASE HER



BUBBLE PICTURES SHOW WHY!



MOST LATHERS are made of bubbles too big to get to the base of the beard! Air pockets keep the soap film from reaching the whiskers. So the beard is only half-wilted.



COLGATE RAPID-SHAVE CREAM makes tiny bubbles that get clear down to the skin-line. Its rich soap film soaks your beard soft at the base. Makes your shaves last longer.

DINNER THAT NIGHT



COLGATE "SKIN-LINE" SHAVES LAST HOURS LONGER



SIMPLIFIED SCALE MODEL OF A

Racy Looking High-Wing Plane

By Donald W. Clark



THE Cessna C34, a four-place, high-wing monoplane powered with a Warner Super Scarab engine, is an interesting design for model makers to follow because of its rakish lines and the fact that it is one of the few planes with single-strut wheel support.

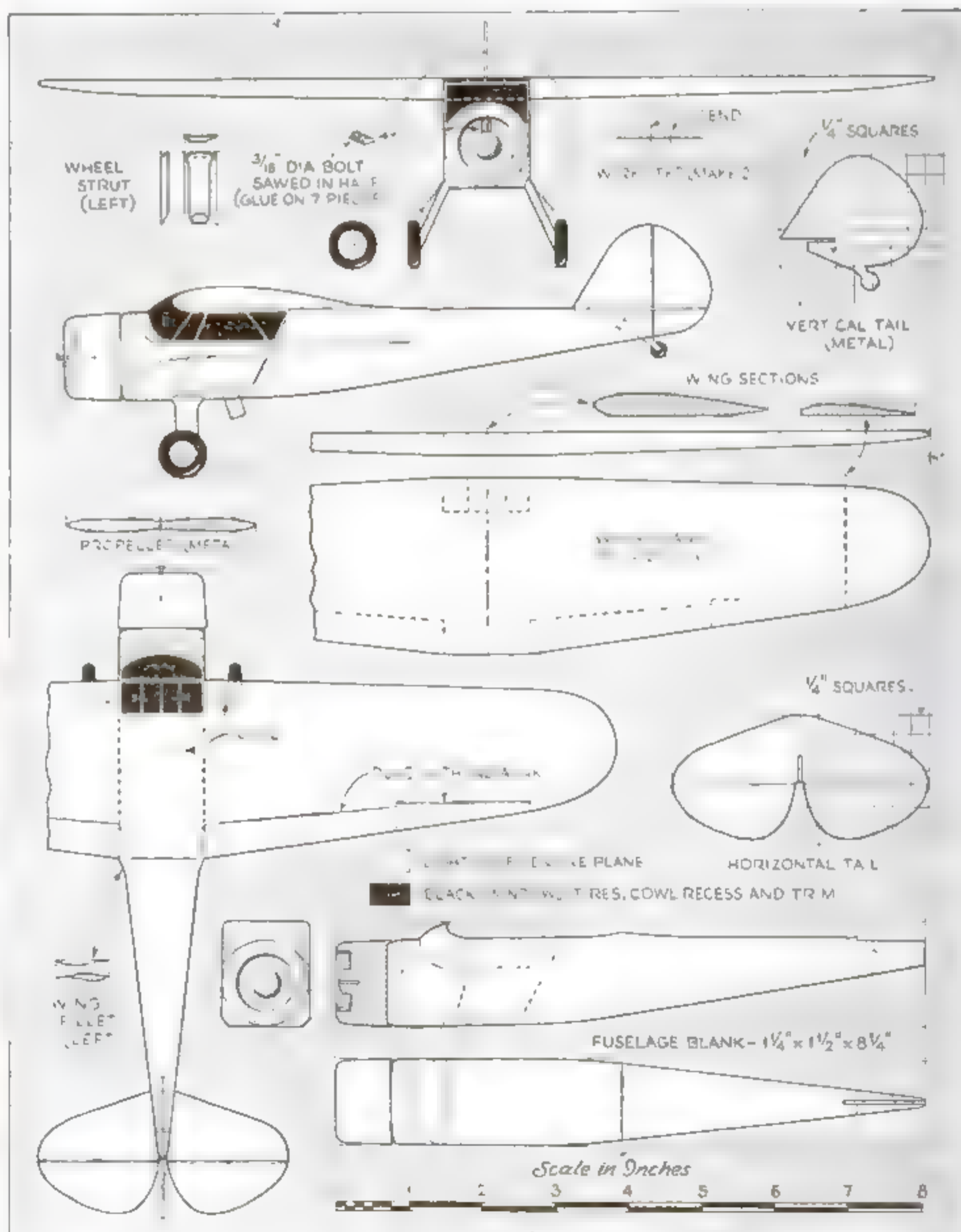
The span of this plane is 33 ft. 10 in., and the length, 24 ft. 7 in. The model is made to the scale of $\frac{3}{8}$ in. equals 1 ft.

There are but ten parts to this model, not

counting the engine cylinders and the steps, and they are all quite easy to make. The engine cowl can be shaped separately and glued in place, or made as part of the body.

An easy way to construct the tail units is to use stiff cardboard and cut them out with a razor blade. This enables glue to be used to help hold them in place. The tail wheel can be stiffened by dipping it in glue.

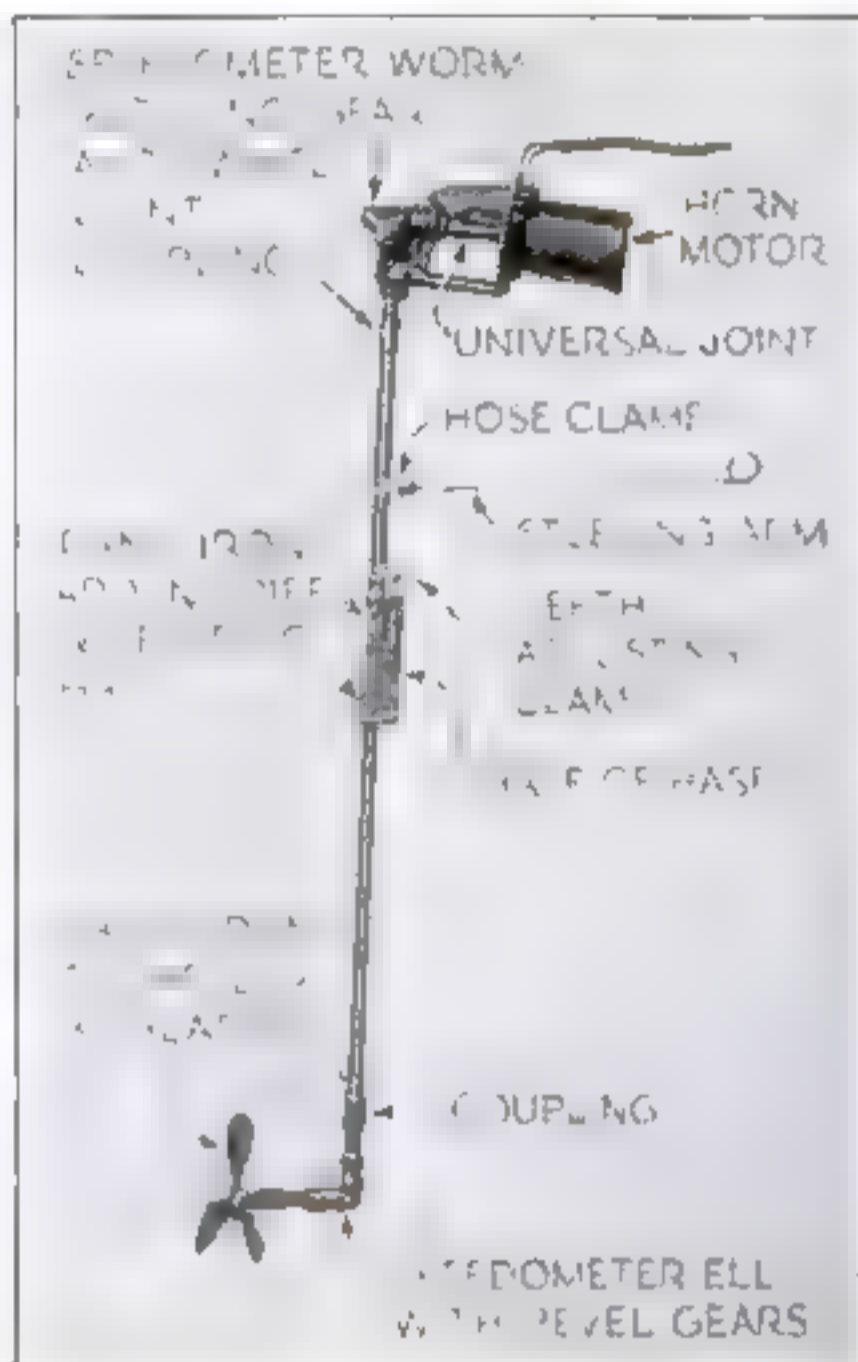
Light blue with black windows, tires, cowl recess, and trim makes a neat color scheme.



Front, side, and top assembly views; and detail drawings of the fuselage, wing, and other parts

HORN MOTOR PROPELS BOAT FOR FISHING

THIS electric outboard motor has been in use for several years on a 14-ft. boat from which I cast for trout or bass in various small lakes or ponds. It is driven by a 6-volt auto battery and is so quiet and smooth that I can slip right up on the old boys. It weighs only 7 $\frac{3}{4}$ lb. without the storage battery. I can steer the boat from any position by attaching

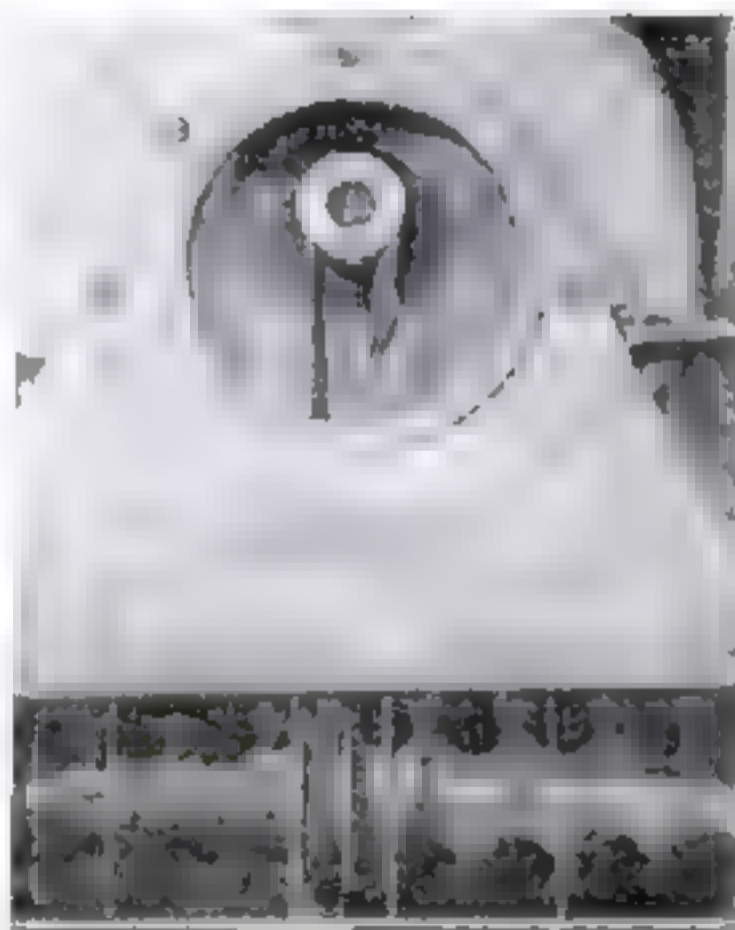


A photograph of the propelling unit with all the principal parts lettered for identification

a cord to the steering lever. The cord runs through screw eyes fastened in the sides of the boat. The propeller is adjustable as to depth, and can be turned completely around in relation to the motor.

The outfit is made from an old auto horn, old speedometer parts, tubing, band iron or sheet iron, a hinged hasp, bolts, and screws. A 20-penny nail fastens the two parts of the hasp together. The part of the hasp not shown is, of course, attached to the stern of the boat.—JOSEPH E. EDWARDS.

VACUUM-CLEANER BELT



Should the belt to the revolving brush of a vacuum cleaner break, an effective substitute is a rubber jar ring of the type commonly used on quart preserve jars. Place the rubber ring in the same position occupied by the belt. Until a new belt has been obtained, this arrangement will be found to work satisfactorily.—J. R. FLAHERTY.

OL' JUDGE ROBBINS



ADDS AN ODD PIPE TO HIS COLLECTION

I PICKED UP THAT ANTIQUE PIPE IN ITALY FOR YOU. IT'S THE FIRST PIPE MADE OF STEEL I EVER SAW

MANY THANKS, RALPH. I HAVE A FEW MORE METAL PIPES IN MY COLLECTION



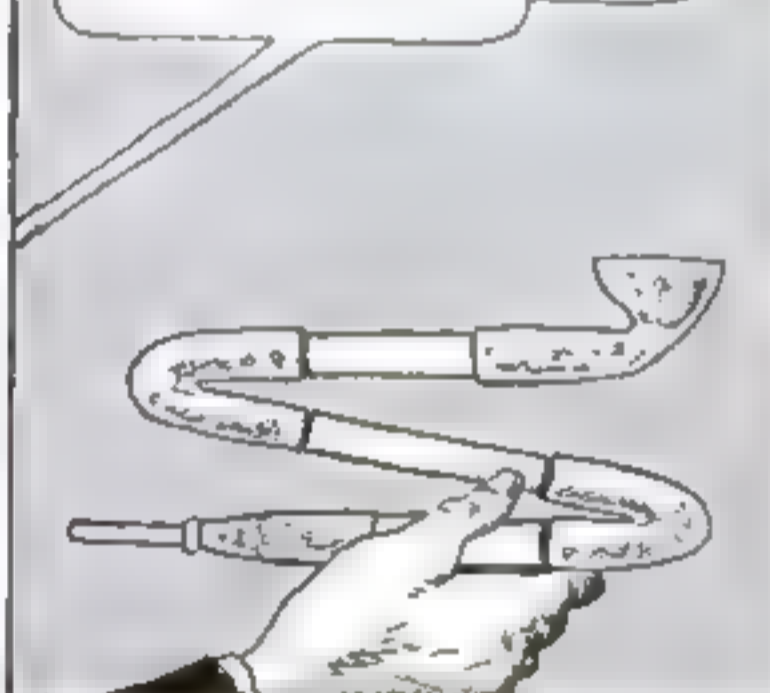
THIS METAL PIPE COMES FROM BURMA. THE ASIATICS USE SO MUCH METAL WORK, IT'S NOT SURPRISING TO FIND PIPES MADE OF VARIOUS ORES



TAKE THIS CHINESE WATER-PIPE, FOR EXAMPLE — A LOVELY THING OF SILVER INLAID WITH ENAMEL

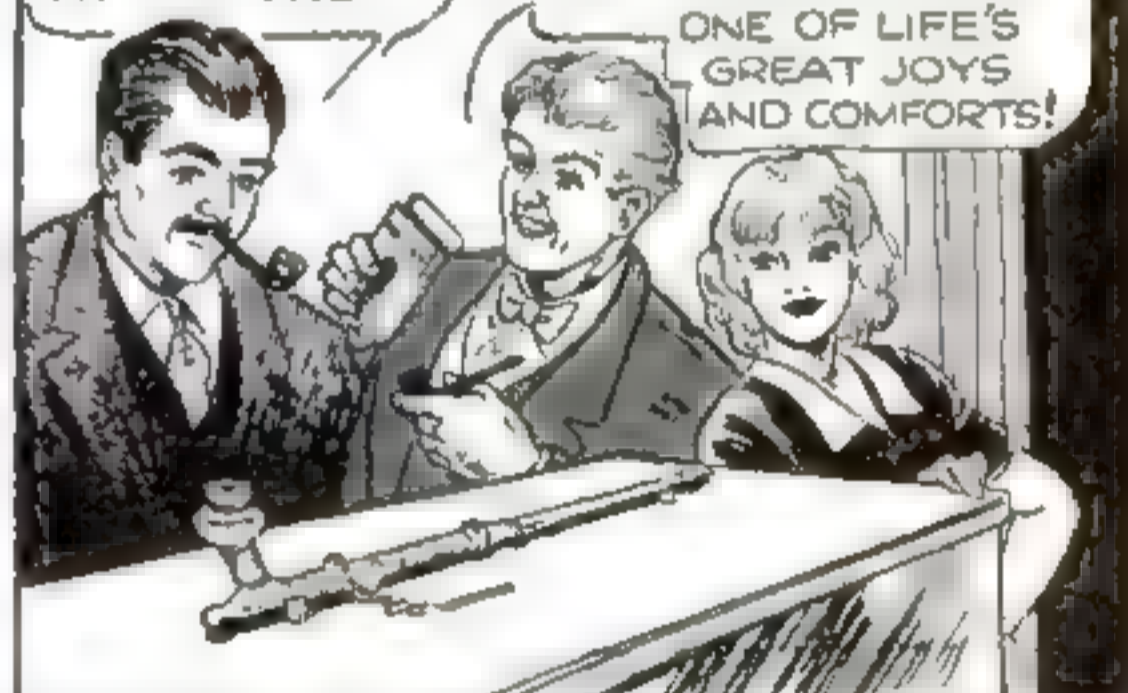


AND HERE'S A RATHER TRICKY JAPANESE PIPE, ALSO OF SILVER, BUT TRIMMED WITH IVORY AND JADE —



I'LL BET THAT COPPER PIPE FROM SUMATRA WOULD GIVE A MIGHTY HOT SMOKE

OPINIONS DIFFER ABOUT PIPES, BUT IT'S SMOKIN' PRINCE ALBERT REGULARLY THAT MAKES A PIPE ONE OF LIFE'S GREAT JOYS AND COMFORTS!



THE BEST "BREAK" A PIPE CAN GET



Smokers who make pals out of pipes agree that Prince Albert is the tobacco for breakin' 'em in—and for forever after! P.A. cakes nicely—smokes sweet. It is "crimp cut" for coolness—does not bite the tongue. The big red tin holds 50 pipefuls. Swell "makin's" for roll-your-own cigarettes too.

© 1936, R. J. Reynolds Tob. Co.



OUR OFFER TO PIPE SMOKERS

"You must be pleased"

Smoke 20 fragrant pipefuls of Prince Albert. If you don't find it the mellowest, tastiest pipe tobacco you ever smoked, return the pocket tin with the rest of the tobacco in it to us at any time within a month from this date, and we will refund full purchase price, plus postage. (Signed)

R. J. Reynolds Tobacco Co., Winston-Salem, N. C.

PRINCE ALBERT

THE NATIONAL JOY SMOKE!



50 pipefuls of fragrant tobacco in every 2-ounce tin of Prince Albert

ECONOMY is one of the BEAUTIES of GENUINE MASONITE TEMPERED PRESWOOD



You do save money when you build things with Genuine Masonite TEMPERED PRESWOOD. This modern board is grainless and absolutely uniform in quality. No need to worry about costly "mistakes" because of knots or imperfections.

TEMPERED PRESWOOD is moisture-resisting. Properly used, it will not warp, chip, split or crack. Joints stay fitted permanently. Finished articles will not bend or curl out of shape.

And you don't need to buy any paint or varnish to achieve beautiful results, because the natural warm-brown surface of TEMPERED PRESWOOD appeals to the most critical eye. Of course, if you wish, you can apply any standard finish.

Ask your lumber dealer for Genuine Masonite TEMPERED PRESWOOD before you start your next "building operation." He can supply it in $\frac{1}{8}$ ", $\frac{3}{16}$ ", $\frac{1}{4}$ ", and $\frac{5}{8}$ " thicknesses. He'll also tell you some of its many advantages for home building and remodeling. Or mail the coupon below for free sample and further details.



Trade-Mark
Reg. U. S. Pat. Off.

MASONITE CORPORATION, Dept. PS-5
111 W. Washington St., Chicago, Ill.

Please send me a free sample and additional information about Genuine Masonite TEMPERED PRESWOOD.

Name

Address

City State



Old
Bill

SAYS:

AN EXCELLENT rust-preventing mixture is readily compounded by melting 4 oz. of rosin in 2 gal. of kerosene oil to which 1 qt. of linseed oil has been added.

Never withdraw a hand reamer from a hole by turning it counterclockwise.

BLUEPRINTS TO AID YOUR CRAFTWORK

MAKE it a point to study our list of blueprints for suggestions before you start a new project in your home workshop. The following is a representative list, but many other blueprints are available. You can obtain a complete list by sending a self-addressed, stamped envelope with your request.

RADIO SETS

All-Wave Portable (battery), 217-R.....	.50
Amateur Short Wave Receiver, 155.....	.25
Amateur Radio Transmitter, 163-164.....	.50
Five-Tube Short Wave (A.C. or D.C.), 223.....	.25
Full Electric Headphone Set, 130.....	.25
One Tube (battery operated), 103.....	.25
Screen-Grid Set, 109.....	.25
Short-Wave Converter Unit, 137.....	.25

TOYS

Doll's House, Colonial, 72.....	.25
Doll's House Furniture, 73.....	.25
Projector for Photos and Pictures, 259A.....	.25
Toy Airplane Cockpit with Controls, 114.....	.25
Toy Birds and Animals, Jig-Sawed, 56.....	.25
Toy Drill Press, Lathe, Saw, etc., 113.....	.25
Toy Dump Truck, Fire Engine, etc., 101.....	.25

SHIP AND COACH MODELS

(Construction kits are available for some of these models. See page 84.)

Aircraft Carrier—U.S.S. <i>Saratoga</i> (18-in.) and flush deck destroyer (6 $\frac{1}{4}$ -in.), 226-227-R.....	.75
Battleship—U. S. S. <i>Texas</i> (3-ft. hull), 197-198-199-200.....	1.00
Bottle, Clipper Ship in, 121-122.....	.50
Clipper Ship (20 $\frac{1}{2}$ -in. hull), 51-52-53-R.....	1.00
Clipper Ship <i>Great Republic</i> (31 $\frac{1}{2}$ -in. hull), 272-273-274-R.....	1.25
Constitution (21-in. hull), 57-58-59-R.....	1.00
Cruiser <i>Brooklyn</i> (8-in.), 236.....	.25
Cruiser <i>Tuscaloosa</i> (11 $\frac{3}{4}$ -in.), 234.....	.25
Freighter, Ocean (14-in.), 271.....	.25
Galleon <i>Revenge</i> (25-in.), 206-207-208-209.....	1.00
Hartford, Farragut's Flagship (33 $\frac{1}{2}$ -in. hull), special prints 221-222-R.....	1.50
H. M. S. <i>Bounty</i> (8 $\frac{1}{2}$ -in. hull), 254.....	.25
Mayflower (17 $\frac{1}{2}$ -in. hull), 83-84-85-R.....	1.00
Motor Boat, 29-in. Cruiser, 63-64-R.....	.75
Motor Boat, Working Model (20-in.), 196.....	.25
Nourmahal, power yacht (8 $\frac{1}{2}$ -in.), 276.....	.25
Liner— <i>Aquitania</i> (9-in.), 225.....	.25
Liner— <i>California</i> (12 $\frac{1}{4}$ -in.), 251.....	.25
Liner— <i>Normandie</i> (20 $\frac{1}{4}$ -in.), 264-265.....	.50
Liner— <i>Manhattan</i> (12-in.), 204.....	.25
Liner— <i>St. Louis</i> (11-in.), 231.....	.25
Liner— <i>Queen Mary</i> (10 $\frac{1}{4}$ -in.), 283.....	.25
Pirate Felucca (20-in.), 44-45-R.....	.75
Privateer of 1812— <i>Swallow</i> , a Baltimore clipper (13-in. hull), 228-229-230-R.....	1.00
Roman Galley (19-in.), 138-139-R.....	.75
Santa Maria (18-in. hull), 74-75-76-R.....	1.00
Show Boat, Illuminated (14-in.), 263.....	.25
Stagecoach with Horses, 144-145-146-R.....	1.00
Steamboat, Mississippi (19 $\frac{1}{4}$ -in.), 94-95-96-R.....	1.00
Trading Schooner (17 $\frac{1}{2}$ -in. hull), 252-253.....	.50
"Treasure Island" <i>Hispaniola</i> (7-in.), 237.....	.25
Viking Ship, (20 $\frac{1}{2}$ -in.), 61-62-R.....	.75

The cutting edges of reamers may be protected, when the tools are to be stored, by wrapping them in several places with gummed tape.

When setting the gauge on a power shear, don't invite costly accidents by using an expensive steel rule or scale. Lay out and scribe a suitable length of scrap metal and use it for gauge-setting purposes.

For fireproofing aprons, overalls, and inflammable material, treat them with a solution composed of one ounce of tungstate of soda to each gallon of water.

A piece of paper pasted over the face of a dial indicator and exposing only a portion of the dial ten thousandths each side of zero will keep the eyes from wandering.

When you are through using a tool, return it immediately to its proper place in as good a condition as you got it. The other fellow deserves a chance.

Whaler— <i>Wanderer</i> (20 $\frac{1}{2}$ -in.), 151 to 154.....	1.00
Yacht <i>Rainbow</i> (7 $\frac{1}{2}$ -in. hull), 233.....	.25
Yacht <i>Sea Scout</i> (42-in. racing), 106-107-R.....	.75
Yacht (20-in. racing), 48-R.....	.50

BOATS

Camper's Boat, 11 ft. 2 in. long (can be rowed or used with outboard), 281-R.....	.50
Canoe, 16-ft. Canvas-Covered Kayak, with sail, etc., 192-193-194-R.....	1.00
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Duck Boat, Folding (13-ft.), 170-R.....	.50
High-Speed Boat for Small Outboard Motors (7 ft. 11 in. long), 257.....	.25
Installing Inboard Motors, 270.....	.25
15 $\frac{1}{2}$ -ft. Runabout or "Sportboat" (outboard or inboard motor), 175-176-177-R.....	1.00
13-ft. Utility Rowboat (can be sailed or used with outboard motor), 224-R.....	.50
13-ft. Racing Runabout, 261-262-R.....	.75

FURNITURE

Chests, Treasure, 78.....	.25
Coffee Table with Spiral Legs, 245A.....	.25
End Table, American Empire, 241A.....	.25
Fireside Seats (wood and metal), 266A.....	.25
Floor Lamp with Tripod Base, 243A.....	.25
Hanging Wall Cabinet, Colonial, 280A.....	.25
Lamps, Three Modern, 93.....	.25
Magazine Rack, Ladder-Back Style, 250A.....	.25
Mirror Frame, 20 by 30 in., 246A.....	.25
Screens, Modernistic Folding, 91.....	.25
Sewing Cabinets, Two, 31.....	.25
Smoking Stand, Modern, 238A.....	.25
Stool, Scoop-Seat, 242A.....	.25
Stool, Upholstered, 240A.....	.25
Table, Four-Leaf Card, 239A.....	.25
Tables, Tile-Top, 249A.....	.25
Tavern Table and Scroll Mirror, 105.....	.25

MISCELLANEOUS

Brass Porch Lamp, Marine Style, 280A.....	.25
Hand Loom, Four-Treadle, 268A-269A.....	.75
Microscope Kit, Portable, 220.....	.25
Modernistic Desk Clock and Instructions for Cutting and Etching Metal with Acid, 262A.....	.25
Perpetual Star Chart, 214.....	.25
Weather Vane, Ship Model Type, 66.....	.25

Popular Science Monthly

353 Fourth Avenue, New York

Send me the blueprint, or blueprints, numbered as follows:

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Street

City and State.....

Please print your name and address clearly.

CAMP TABLE AND CHAIRS FOLD UP COMPACTLY

(Continued from page 65)

the assembly will be difficult or impossible. The bottom ends of the legs also should be beveled. If the furniture is to be used on a hard surface such as a floor, it is advisable to round the bottom ends of the legs of the seats as well as the table, but if they are to be used on soft turf, the flat ends will resist sinking into the soil better.

The top for the table is constructed from 1/2-in. wood, 8 in. wide and 24 in. long. Three pieces are necessary. The pieces are fastened with hinges, and two strips should



One of the table legs has an elongated, box-like hinge so that all the legs may be folded

be screwed to the central piece in such a manner that they can be swung over the cracks to stiffen the table.

For finishing the wooden parts, shellac or spar varnish will give a better surface than paint, as it will not become marked so quickly.

For packing, the three panels of the top are folded to form an open-sided box in which the four chairs can easily be stowed away. A canvas case, 8 1/2 by 9 by 24 in., should be made to carry the outfit. The case or bag can be closed at the end with a patent fastener or by means of eight grommets through which a cord can be passed.

ELASTIC WAIST CORD IS AID IN SQUARE-KNOT WORK

SQUARE-KNOT work can be done with greater speed and a more uniform tension can be maintained on the so-called "standing" cords if an elastic waist cord is used. Such a cord may be made by looping rubber bands together or by cutting an old inner tube. Commercial elastic, of course, can also be used. I have found this idea helpful when used with the hook described in a previous issue (P.S. M., Jan. '36, p. 76).—H. F. GREGGERSON, JR.

FREE BULLETIN TELLS HOW TO START CLUB

THE methods by which you can start a home workshop club in your own community are explained in a free bulletin, which may be obtained by filling out the coupon below. Information is given on how to get in touch with prospective members, how to call the first meeting, how to conduct it, and how to complete the organization in such a way as to insure success.

National Homeworkshop Guild
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I am interested in the home workshop club idea and wish to know how to organize a club. Please send me this information in the large self-addressed and stamped envelope I am inclosing.

Name
Address
City State.....
(Please print very clearly)



**AW—THAT'S NO
REASON, JEAN—
C'MON AND GO
WITH ME...**

Pimples were wrecking Harry's "dates"



—clears the skin
by clearing skin irritants
out of the blood

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Don't let Adolescent Pimples make YOU feel deserted

AFTER the beginning of adolescence—from about 13 to 25, or even longer—many young people have pimples. At this time, important glands develop—and final growth takes place. The entire system is disturbed. The skin gets oversensitive. Waste poisons in the blood irritate this sensitive skin. Pimples pop out!

Fleischmann's Yeast helps overcome adolescent pimples. It clears these skin irritants out of the blood. Then—pimples go! Eat 3 cakes every day, one before each meal—plain, or in a little water—until your skin clears.



TWO WEEKS AGO this black, tarry-looking substance, that you wouldn't buy at any price, was a fine high grade oil . . . taken out of a sealed can and put in the completely drained crankcase of an engine that was not protected by an oil filter. Today, this once fine oil has already begun to develop sludge . . . and to accumulate the dirt and grit and hard carbon that always find their way into an engine. These harsh, destructive substances are sources of costly replacements and repairs . . . for they are carried by the oil stream into closely fitted moving parts, where they grind away at valves and cylinder walls and bearings.

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Kits for Building Ship Models



KIT V—Materials for this clipper ship

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The simplest kits are those prepared for members of the Popular Science Model-of-the-Month Club. So long as the supply lasts, certain of these kits are also made available at the same prices to readers who are not members of that club. The kits which can still be supplied are given in the following list.

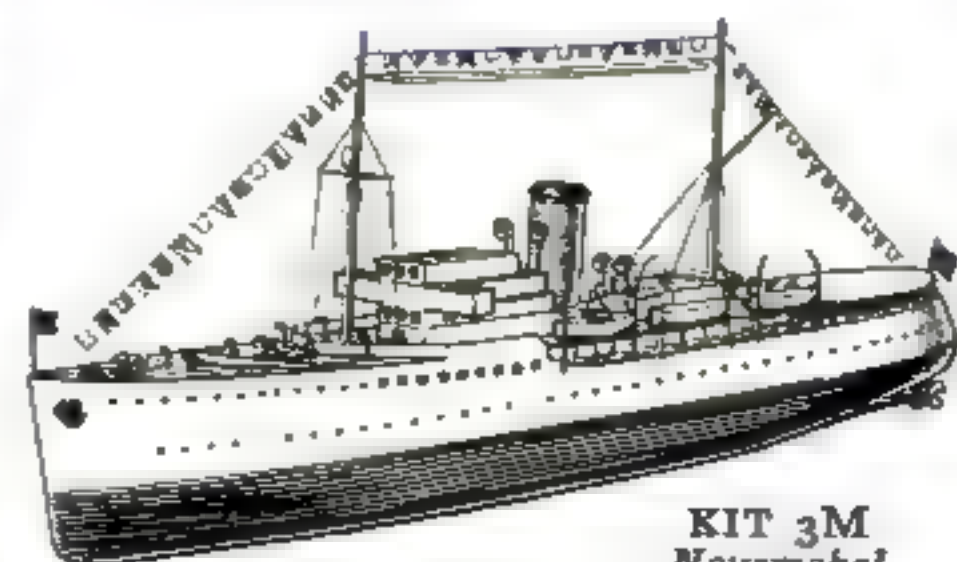
Our standard ship model kits are of a much larger and more elaborate type. All necessary raw materials are provided, and the hull blocks or "lifts" are sawed to shape. Similar in general construction to these models, but smaller and greatly simplified, are the ones listed under the heading, "Simplified Ship Model Kits." Each kit is accompanied by the necessary blueprints and instructions.

In addition, we have two special whittling kits and two furniture kits containing completely machined parts of the highest quality, ready for assembly.

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R. U. S. cruiser <i>Tuscaloosa</i> , 11¼-in.	1.00
U. <i>Hispaniola</i> , the ship in "Treasure Island," 7-in.	.50
Z. H.M.S. <i>Bounty</i> , 11½-in.	1.50
1M. Show boat, illuminated, 14-in.	1.50
2M. Ocean freighter, 14-in.	1.50
3M. Yacht <i>Nourmahal</i> , 8½-in.	1.00

(Continued on page 85)



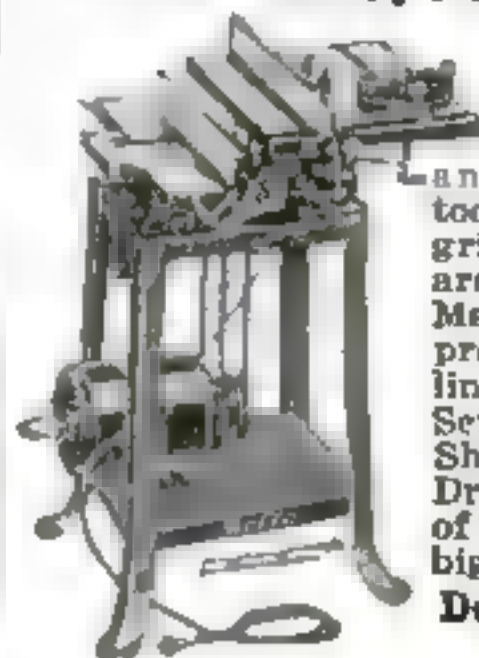
KIT 3M
Nourmahal



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OUR CONSTRUCTION KITS

(Continued from page 84)



KIT 1M—An illuminated show-boat model

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- D. Spanish galleon, 24-in. 6.95*
- E. Battleship U.S.S. *Texas*, 3-ft. 7.45*
- G. Elizabethan galleon *Revenge*, 25-in. 7.25*
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- Q. Privateer *Swallow*, 12½-in. hull.... 4.95†
- V. Clipper *Sovereign of the Seas*, 20½-in. hull 4.95†
- Y. Trading schooner, 17½-in. hull..... 4.90†
- 2S. U. S. Destroyer *Preston*, 31½-in. hull 5.95*
- 3S. *Constitution* ("Old Ironsides"), 21-in. hull 6.50*
- 4S. Clipper ship *Great Republic*, 31½-in. hull 8.40*

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- J. Clipper ship *Sea Witch*, 13-in. 1.50

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by Frank Buck, Author of "Bring 'em back alive"

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That's why it was almost tragic when I ran out of Gillette blades a few months ago up in the jungle of Negri Sembelin. But I found them in a little kedai, or native trading post, located on a bullock-cart trail leading into a dense Malayan jungle.

I didn't know then why the Gillette blade stands head and shoulders above all others for quality—why it gives me clean, easy shaves under all conditions. That was before I visited the Gillette factory in Boston, and got the surprise of my life!

I never dreamed it took so much care and effort to produce the Gillette blade. I saw ribbons of finest Swedish steel put through one elaborate and precise process after another. I saw them perforated, hardened, tempered, ground, honed, stropped

and cut into individual blades by machines that are almost unbelievably accurate. I met skilled technicians who supervise the ingenious scientific devices that constantly check and double-check for quality. I couldn't imagine such rigid inspection.

Yes, these blades—in department after department—seem to be examined as closely as a bacteriologist searches for microbes on a slide. And after the final inspection the blades are sprayed with a special antiseptic solution and placed in their sanitary waxed paper wrappers.

Now I know why I can shave every day, in the jungle or out, and actually enjoy it! And that goes whether I buy my Gillette blades in New York, London or Paris—Calcutta, Singapore or Shanghai. They're the same, the world over, equally sharp and smooth-shaving. No wonder wild animals can't keep me from shaving with Gillette blades.

Here are the facts about razor blades. Why let anyone deprive you of shaving comfort by selling you a substitute? Ask for Gillette Blades and be sure to get them.

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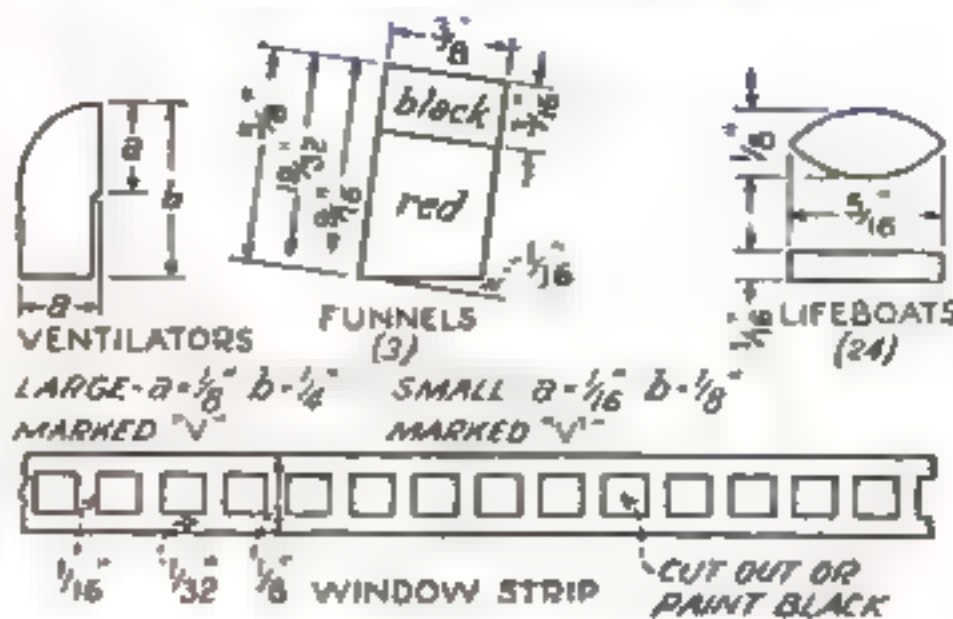
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I am also interested in news for

MODEL OF QUEEN MARY

(Continued from page 74)



The ventilators, which are made in two sizes, funnels, lifeboats, and part of window strip

It is advisable first to shape piece A into the hull. The heavy line represents the deck line and should be cut out first. The sides should then be whittled down so that the water-line conforms to the shape of the dotted lines in the plan of part A. The shaped hull may then be used as a guide for shaping pieces B, D, H, and G to match the sides.

When all the pieces are shaped, it is best to set them all in their proper places on the hull without using glue in order to get a clear idea of where the various parts are to go, and also to detect any inaccuracies in shaping.

Glue together the parts that constitute the superstructure as a separate unit from the hull. This will enable you to paint these units separately and then join them after the paint is dry. Since the sides of the hull are black and the superstructure white, a clean-cut division line will result. (Continued on page 87)

List of Materials

BALSA WOOD

No. of Pieces	T	W.	L.	For
1	7/16	1/8	10 1/2	A
1	1/8	1/8	1/8	B
1	1/4	1/8	6 1/2	C*
1	1/16	1/8	7/8	D
1	1/8	1-1/16	7/16	E
1	1/16	1/8	13/16	F
1	1/16	1/8	1/8	G
1	1/16	1/8	1/8	H
1	1/16	1/8	1/8	I*
1	1/8	1/8	5/8	J*
1	1/16	1/8	11/16	K
1	1/16	5/16	15/16	L
1	1/16	9/16	8	M
1	1/16	1/2	1 1/4	N
1	1/16	1/8	5/8	O
3	1/32	5/16	2	P*
1	1/16	3/16	7/8	Q*
1	1/16	5/16	1 1/4	R*
4	1/16	1/16	5/8	S*
1	1/16	1/8	1/2	T*
1	1/16	1/8	5/16	U*
1	1/16	1/16	1/8	V*
1	1/32	1/16	1	W*
2	1/16	1/16	3/16	X
1	1/8	5/16	2	Lifeboats
1	5/16	5/16	2	V, Large Ventilators
1	3/16	3/16	1	V', Small Ventilators
1	3/8 rd.		3	Funnels

NOTE: All dimensions are given in inches. The items marked with an asterisk (*) require no further cutting or shaping. The other parts should be shaped as shown in the drawings, which are lettered to conform to this list. White pine, basswood, spruce, or other softwoods may be used in place of balsa if available in the correct thicknesses.

MISCELLANEOUS

2 needles 2 in. long for masts.
2 pc. thin stiff wire 1 3/4 in. long for booms.

Black, white, buff, and vermilion paint. (White, with the addition of a very little vermilion and a trace of black, will serve for buff.)

Glue or cement.
Very fine sandpaper.

In every good work-shop



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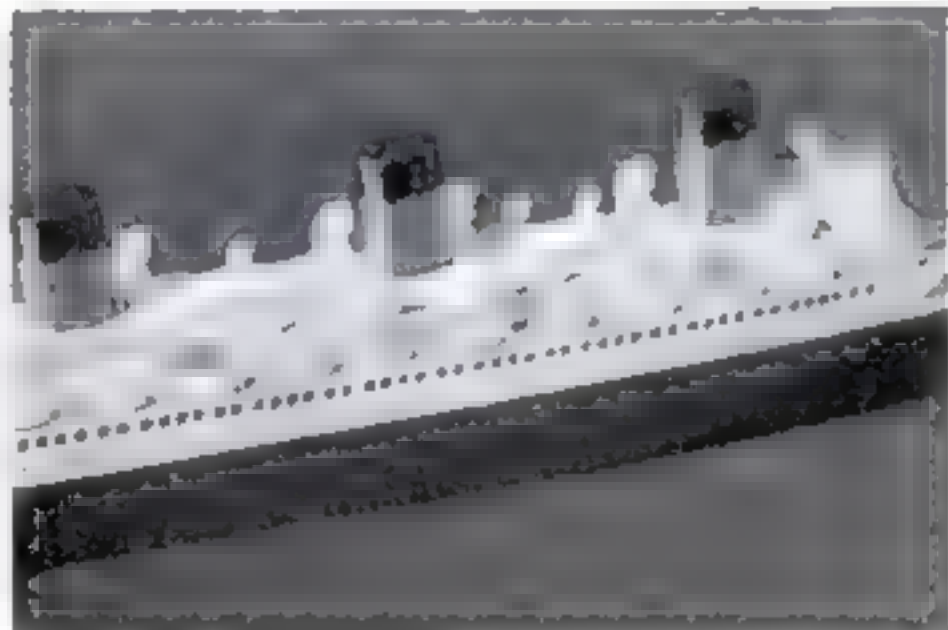
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MODEL OF QUEEN MARY

(Continued from page 86)

Make twenty-four lifeboats from a $\frac{3}{8}$ by $\frac{5}{16}$ -in. stick. Sandpaper the corners of the stick to shape, mark $\frac{1}{16}$ -in. spaces along the length, and cut the boats, as if slicing bread, with a sharp, thin razor blade or knife. Fasten the boats in the positions indicated.

The ventilators are a unique characteristic of the ship. In place of the usual cowl-type ventilator, the *Queen Mary* is provided with large box-shaped ventilators that form an important part of her silhouette. Care must therefore be used in cutting and shaping these



A photograph showing most of the superstructure, the funnels, ventilators, and lifeboats

ventilators so that all are alike in shape and size. Their positions are clearly shown.

The funnels are made by flattening two sides of a $\frac{3}{8}$ -in. dowel by planing or sandpapering, so that an oval shape, $\frac{3}{8}$ by $\frac{1}{4}$ in., results. In cutting the funnels to length, notice that they are not of equal height.

It is advisable at this stage to complete the painting of the various units. As mentioned previously, the sides of the hull are black, and the sides of the superstructure, white. All exposed portions of the deck on A, B, C, D, E, G, H, I, and N are painted light buff. The topside of J from abreast the third funnel all the way aft is also light buff. The best method is to give all the superstructure a coat of flat white, and, when this is dry, to apply the buff as a second coat where specified.

The ventilators and lifeboats are painted white and affixed to the superstructure after the paint is dry. The funnels are vermilion with black tops. The black band is $\frac{3}{16}$ in. wide. Touch each of the ventilators where the opening should be with the same vermilion used for the funnels. The masts and booms are painted buff. All these items should be painted before they are attached.

The model illustrated was provided with what might be called a "window strip" fastened along the edge of C over a black stripe. The strip is made by punching or cutting out small squares in a strip of bristol board $\frac{1}{8}$ in. wide. Those who find this task too tiresome may simply paint or ink in the squares on the strip before fastening it to the model.

HANDY ROPE FOR MOTOR BOAT


A GENERAL utility rope for the runabout or small cruiser can be made by splicing a snap hook to each end of a rope 25 ft. long or longer. The boatman who likes to keep his decks clear of rope will find it useful as a bow line or stern line. One end can be clipped quickly to a ring on deck, while the hook on the other end acts as a weight and makes it easier to throw the line to a person on the shore or wharf; at the same time, it provides that person with an easy method of fastening the rope without resorting to an unreliable landlubber's knot. When not in use, the rope may be kept within easy reach of the steering position so as to be ready for immediate use. The snap hooks should be made of brass or galvanized iron, if possible; otherwise they should be well painted. Permanent bow and stern lines also can be improved by splicing snap hooks to their outer ends. —G. A. R



His eyes need plenty of good light!
For his sake use Edison MAZDA lamps
...they stay brighter longer



YOUNG EYES need more light for studying, reading and other close work than middle-age or mature eyes. For the strain of using eyes in poor lighting can affect not only the eyes but the entire nervous system. That's why it is so important to provide young eyes with good light... light from good bulbs that stay brighter longer. The General Electric

monogram  on a bulb is your assurance of good light... of sight-saving light... at low cost. Edison MAZDA lamps now cost as little as 15¢... only 20¢ for the popular 100-watt size. Ask for these lamps by name.

THE G-E "DIME" LAMP. The first real value in a 10 cent lamp. Comes in the following sizes, 60, 30, 15 and 7½ watts. It is marked like this G E



END OF THE MAN ON THE FLYING TRAPEZE



HE fell from the bar with the greatest of ease when the fumes from that goosy briar got him. Won't some usher please rush out for a pack of pipe cleaners and a tin of Sir Walter Raleigh's peaceful blend—and let the show go on? Sir Walter burns slower, cooler. The air stays cleaner, your tongue stays calmer, and its delightful aroma wins applause from any crowd. Sales go up and up as smoker after smoker finds Sir Walter Raleigh the answer to a pipe-lover's prayer for mildness and fragrance. Sold everywhere. Ever tried it?

SWITCH TO THE BRAND
OF GRAND AROMA



FREE booklet tells how to make your old pipe taste better, sweeter; how to break in a new pipe. Write for copy today. Brown & Williamson Tobacco Corporation, Louisville, Kentucky. Dep. Y to



GUILD OFFERS FREE CHARTERS TO CLUBS

(Continued from page 61)

or the secretary of the club. It should give the official name of the club as it is desired to have it appear on the charter and the names and addresses of the officers and members.

That is all there is to it. When the application is approved by the officials of the Guild, the club will become entitled to all the benefits of affiliation with what is now everywhere recognized as the leading organization in the home workshop field.

On its part, the Guild will send to each club a signed and sealed charter suitable for framing and official affiliate cards for the individual members. It will supply the clubs thereafter, so long as they maintain their official standing in the Guild, with bulletins containing a variety of information of practical value. Methods of obtaining speakers, special dem-

ADVISORY COUNCIL

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New York University

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Dean of the School of Industrial
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Capt. E. Armitage McCann
Founder, Ship Model Makers' Club

Dr. Francis G. Pease
Astronomer, Mt. Wilson Observatory

Frank A. Vanderlip
Banker and Publicist, New York

onstrations, plans, and the like will be outlined from time to time. In addition, various free job sheets, booklets, and blueprints will be made available for the club library. The club members will also be entitled to participate in any exhibitions and contests the Guild may sponsor, such as the great national home workshop exhibition and contest held in Chicago last year (see P.S.M., June '35, p. 57) at which \$2,000 in cash prizes and many silver cups, trophies, and medals were distributed.

For affiliation with the Guild, the national dues were originally fixed as fifty cents a member a year, this money to be used solely for expenses of promoting the home workshop club movement and not for salaries of officers or anything of that kind. No officer or director of the Guild has ever received any salary from dues. The expenditures of the Guild have been far greater than the dues received, the difference being made up mainly by POPULAR SCIENCE MONTHLY, official magazine of the Guild. The financial contribution of this magazine is now being materially increased, so that it is possible for the Guild to waive all dues for 1936 from clubs entering the Guild under this new special offer.

In fairness to clubs already affiliated with the Guild—clubs to which unlimited credit should be given because of their enthusiastic and energetic support of the movement in its early stages—the Guild will likewise waive all 1936 dues for any new members they add to their rolls up to July 1. Secretaries should send lists of these members to Guild headquarters, and individual affiliate cards will be issued for 1936 without charge. (Continued on page 89)

D I G

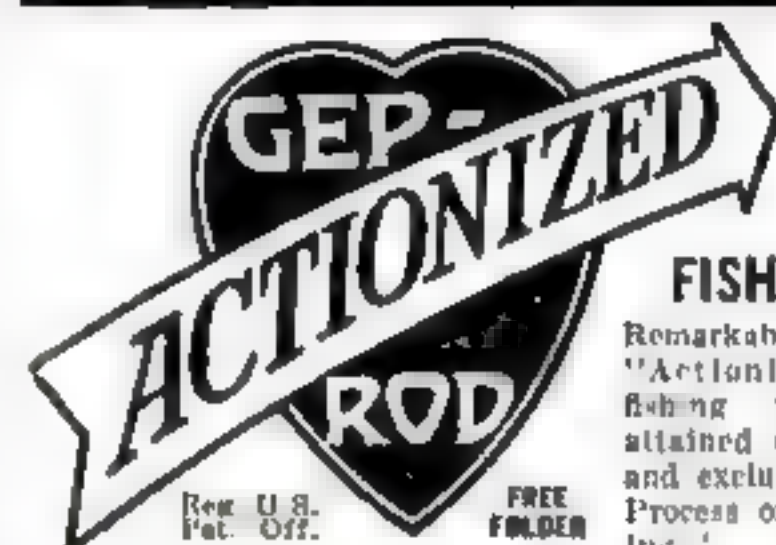


in the
deep, dark
water...

Load up your
duffle, some
grub and an
axe. Strike out
for sport in the

wilds. Follow the ribbons of water with ease... with the stroke-stroke-stroke of an Old Town. It's an Indian craft that's brought up to date! Light and responsive and tough.

See all the different models in the new catalog. Write for a free copy. Models for paddling, sailing or klicker. Prices start at \$68. Also a fine fleet of outboard boats, including large, seaworthy types for the family. Rowboats. Dinghies. Write today! Old Town Canoe Company, 215 Main St., Old Town, Maine.

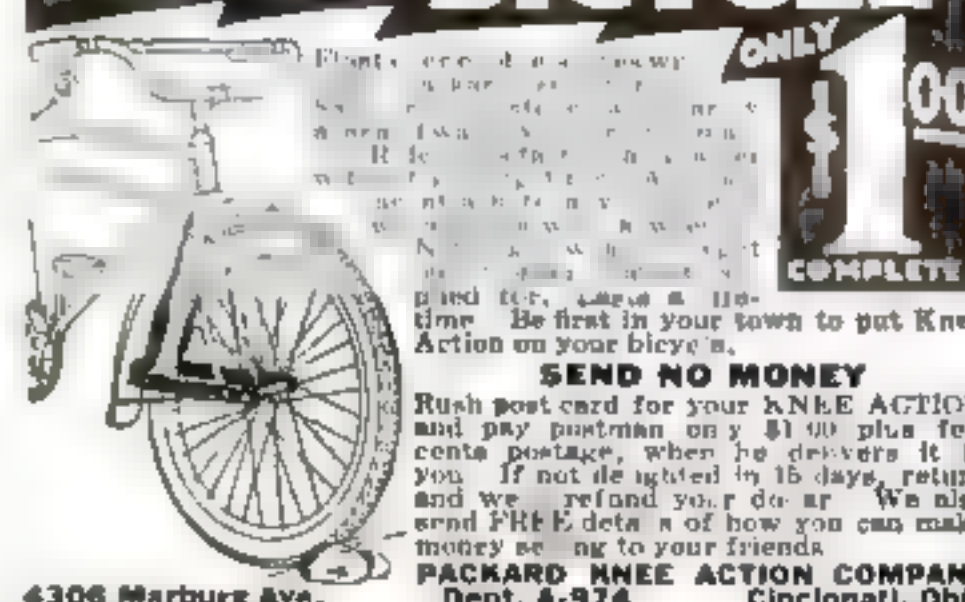


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"Actionizes" steel
fishing rods—action
attained only by new
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Process of "Actionizing"

Also new streamline Vacuum Fit Forward Grip. Be one of the first to enjoy Actionized. Vacuum Fit Gephart Rods. Styles for Salt Casting, Fly Casting, Salt Water. See your dealer at once. Send for free folder. GEPHART MFG. CO., 226 W. Illinois St., Chicago. Specialists in Steel Fishing Rods.

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Build a model like this. 323 S. Georgia Ave., Portsmouth, Va.

GUILD OFFERS FREE CHARTERS TO CLUBS

(Continued from page 88)

The past month has been a notable one in the history of the Guild. The moving of headquarters from Rockford to New York was a step that had long been under consideration. The Guild had obviously outgrown the facilities of its old headquarters, yet it was not easy to leave Rockford because that city was really the birthplace of the organization.

The whole movement had been started as a result of the success of the Rockford Homecraft Club. LeVern T. Ryder, president of the Guild, and E. Raymond DeLong, secretary, both of whom are residents of Rockford, had been the leading spirits in the organization from the very start and had long struggled with the almost overwhelming details of its administration. Busy men with many responsibilities of their own, they had been compelled to sacrifice a great deal of their leisure time to Guild affairs. Their task was made more difficult, too, because the editorial offices were in New York, and the 1935 national exhibition, as a matter of convenience for the local clubs, was held in Chicago. A great increase in efficiency was therefore certain to follow the centralization of activities in New York, and for this reason the change was finally determined upon.

At the same time this move was being made, a spontaneous increase of activity among the local clubs became apparent. Many of the clubs reported an influx of new members, and the following new clubs were organized and granted charters: Chattanooga (Tenn.) Homeworkshop Club; Dover (N.H.) Homecraft Club; Hyattsville (Md.) Woodworking Club; Walla Walla (Wash.) Homeworkshop Club; Terre Haute (Ind.) Homeworkshop Club; "Y's" Craftsman's Guild, Victoria, B. C., Canada; Wilmington (Del.) Homeworkshop Club.

HOME WORKSHOP CLUBS REPORT ACTIVITIES

Hyattsville (Md.) Woodworking Club. Demonstrations on the use of the jointer and drill press were given at a recent meeting. The members met on another occasion at the home of Paul Smith, of the Washington Navy Yard. He gave a demonstration on wood turning and presented the club with a gavel of Osage orange.

"Y's" Craftsman's Guild, Victoria, B. C., Canada. Groups are being formed in this new club to take up the study of pottery, photography, inlaying, basket making, practical electrical work, and scale model making. Arthur R. Cann, acting secretary, showed a variety of inlaid and fret-sawed projects at a recent meeting; Mrs. E. Hamilton gave a talk on basketwork and pottery; and Eric Wood volunteered his services as an instructor in model making. The club has been assigned space in the Y. M. C. A. for use as a workshop. Charles Keeping is acting president.

Topeka (Kans.) Homeworkshop Club. The silver cup won by the club as first prize for civic activities in the National Guild Contest last year has been placed permanently on display in the club library. . . . Both the photography and the woodworking classes are holding regular meetings twice a month.

Brunswick (Me.) Homeworkshop Club. An eight-reel motion picture on the building of an automobile was presented at a recent meeting in the Science Building, Bowdoin College. The program was arranged by Stanton Francis. . . . Another evening was devoted to a trip through a paper mill, the various processes being explained by Harry Walker.

Louisville (Ky.) Homeworkshop Club. The 1936 officers are F. E. Hunziker, president; E. P. Hill, vice president; and E. F. Schmidt, secretary.

Chickasaw Home- (Continued on page 90)

FOR A QUICKER JOB!



WATERSPAR
ONE-COAT ENAMEL
1 Coat-it's done
4 Hours-it's dry

PORCH furniture shabby? Woodwork, shelves, bookcases need a new lease on beauty? Refinish them with Waterspar Enamel. One coat and they're done—four hours and they're dry. We call it a "different" enamel. You'll call it wonderful.

Waterspar flows on smoothly, leaves no brush marks, covers painted surfaces solidly in one coat. Dries to a china-like gloss. Pleasant odor while applying and drying. Resists grease, grime, hard knocks, and washes well. Comes in 28 beautiful colors. *And costs no more than ordinary enamels.*

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HOW FAR CAN YOU GO...

The "FIRST QUART" Tells the Story

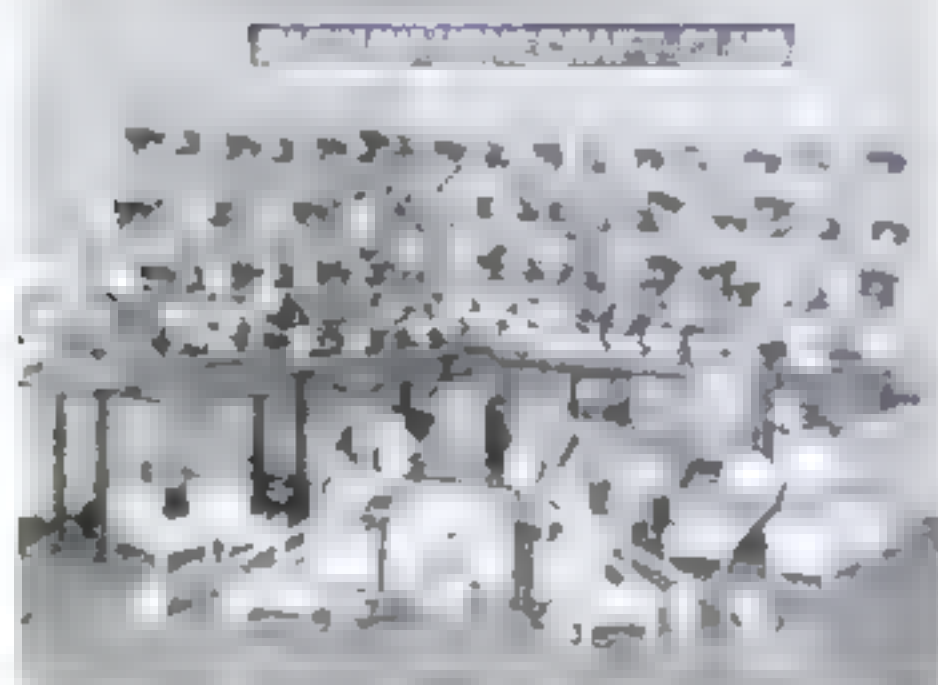
Out of the experience of thousands of motorists has been developed a simple method of comparing oil performance... the "First Quart" Test. It is just a matter of noting how many miles you go after a drain-and-refill before you have to add a quart. If you are obliged to add oil too frequently, try the "First Quart" Test with Quaker State. See if you don't go farther before you have to add that tell-tale first quart. And, the oil that stands up best between refills is giving your motor the safest lubrication. Quaker State Oil Refining Company, Oil City, Pa.

Retail Price... 35¢ per Quart



HOME WORKSHOP CLUBS

(Continued from page 89)



The Saginaw Club's outstanding achievement the past year was in making nearly 400 toys

workshop Club, Memphis, Tenn. The officers for 1936 are David V. Johnson, president; John S. Rouilhac, vice president; J. G. Gates, secretary; Joe B. Rawlings, treasurer, and J. W. Ennis, librarian. These men, together with J. R. Hartie and Clyde Mankin, form the board of governors. . . . G. E. Shofner gave a demonstration on the use of an electric router at a recent meeting.

Capital Homecraft Club, Washington, D. C. A talk on "Electric Motors for the Home Workshop" was given at a meeting held in the home of Lewis E. Johnson. Mr. Johnson has been elected president and Edwin S. Houck treasurer for 1936, and the term of Ellsworth D. Jones, secretary, has been extended for another year. The club has increased its membership sixty percent within a year.

Saginaw (Mich.) Homecraft Club. T. J. Paquette has been elected president for a third term. Walter Tarrant is vice president; L. E. Foglesong, secretary; Merle Hedrick, treasurer, and Ernest DeFore, librarian. These and Art Kneuss and George Parent compose the board of governors. Robert Kolb has been chosen as the club mascot. . . . The final report on the club's toy project showed that nearly 400 toys were made and given to the Salvation Army for distribution.

Cheyenne (Wyo.) Homeworkshop Club. Several one-member exhibitions of craftwork have been given in the window of a local store. The work of W. F. Winkle was the first to go on display, and it was followed a week later by projects made by D. R. Kinports. Other members will show their handicraft in turn. . . . W. C. Schlosser gave a demonstration on woodworking machines at a recent meeting in the Junior High School.

Wilmington (Del.) Homeworkshop Club. Eighteen members turned out for the first meeting of this newly formed club. James A. Oberly was elected president; O. L. Dunn, vice president, and John H. Davidson, secretary and treasurer. Kenneth McKnight, Earl L. Hood, and George W. Ludvigson were chosen to serve with the officers on the board of governors.

Louisville (Ky.) Homeworkshop Club. The members have already started making small toys to be stored away and used as donations to local charitable organizations next Christmas. . . . The club has celebrated its first birthday and looks forward to tripling its membership before the end of 1936 in view of the interesting and educational meetings that are being planned.

HOW TO START A CLUB

A BULLETIN telling in detail how to start a home workshop club and conduct it successfully will be sent free to any reader who incloses a large self-addressed envelope with his request. Address National Homeworkshop Guild, 347 Fourth Avenue, New York.

Clip YOUR WAY

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To The Victor Safe & Equipment Co.
536 Payne Ave., No. Tonawanda, N. Y.
Please send free packet of MAX-UR-OWN Index Tabs advertised in POPULAR SCIENCE, May 1936.

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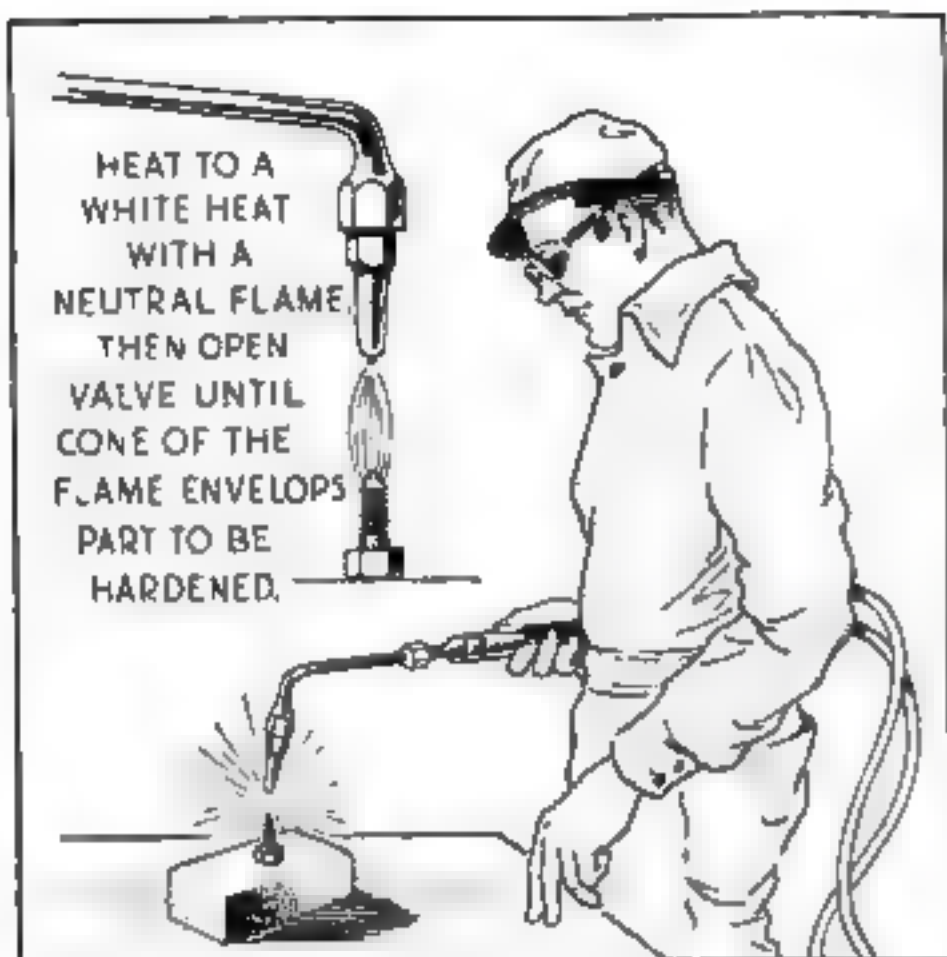
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65 Years Of Progress

USING ACETYLENE TORCH TO CASEHARDEN STEEL



IN ORDER that tool steel may be formed from mild steel, it is necessary to add carbon to the mild steel. This can be done only by bringing the mild steel to its critical temperature, about 1,470 deg. F., and placing it in the presence of carbon. The safest, quickest and most satisfactory way to do this on a small scale for casehardening purposes is with the acetylene torch.

Take, for example, a 1/2-in. mild steel cap screw, which we wish to harden for use as a set screw. After cleaning the screw so the point is bright, place it on a piece of brick or similar material with the point up. Select a tip for the torch with a jet of about 1/16 in. Light the torch and bring to a neutral flame. Heat the screw to a white heat at the point, but be careful not to burn it. Now increase the acetylene until the flame has an acetylene cone about 2 in. long. Keep the tip of this cone on the end of the set screw for about two minutes; then plunge the screw into cold water. This will form a case about .01 in. deep and file hard. Greater depth may be obtained by applying the flame for a longer time, and greater hardness by quenching in soldering acid.



Casehardened cap screw. Note smoothness of point

This will serve as a guide, and one may harden larger or smaller articles in proportion. Before attempting gun parts, taps, punches, and the like, it is best to do some experimenting.

Almost every day we have use for this method in the shop. For example, we had a job that required the threading of several hundred pieces of thin brass pipe. To put each piece in the lathe would absorb all the profit, so we made a die of mild steel, hardened the cutting edge with the torch, and finished the job in short order. Similar savings may often be effected if this use of the acetylene torch is kept in mind.—W. C. CHENEY.

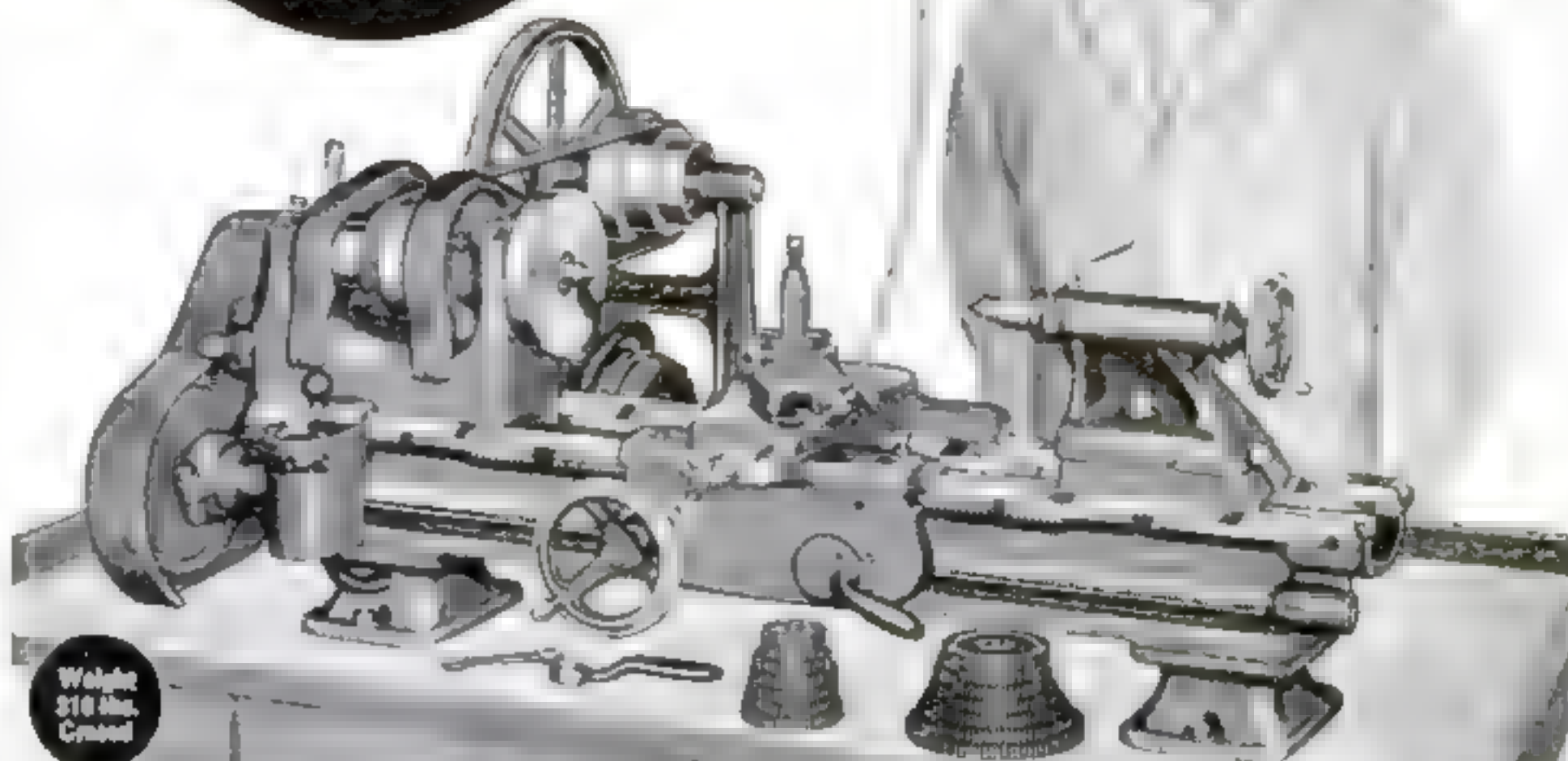
STRIPS FROM OLD INNER TUBES USED IN PLACE OF CLAMPS

A good emergency clamp, especially for irregularly shaped work, can be made by cutting a long strip of rubber from an old inner tube and wrapping it around the pieces to be held. If the rubber is stretched hard and one winding is put over another, great pressure can be obtained. One application of this idea is in making archery tackle. Rubber bands about 1 in. wide are used to bind on extra stock for bow handles while the glue is setting and also to bind the steamed ends of reflexed bows to the form which holds them in shape until the wood dries.—CORNELIUS BADIK.

The New 1936 SOUTH BEND 9" x 3' WORKSHOP LATHE A Precision Back-Geared Screw-cutting Lathe

\$75 LESS MOTOR DRIVE
NO DOWN PAYMENT
3 YEARS TO PAY

Operates from lamp socket



9 1/2" swing by 3' bed 1936 Model Workshop Bench Lathe with Horizontal Motor \$98.25
Drive including 1/4 H.P. motor, reversing switch and lathe equipment complete as shown.

The 1936 Model 9" Workshop is a genuine South Bend Lathe designed and manufactured with the same high quality workmanship and materials that have characterized 70,000 other South Bends during the past 30 years of exclusive lathe building.

Features include Twin gear reverse to leadscrew, Ball thrust bearing on spindle, automatic longitudinal screw feed to carriage, precision leadscrew for cutting screw threads from 4 to 40 per inch, 3/4" hole through spindle, takes collets up to 1/2", set-over tailstock for taper turning and many others. Also available in 3 1/2', 4' and 4 1/2' beds and in 8 different drives, at similarly low prices.

NO DOWN PAYMENT 3 YEARS TO PAY

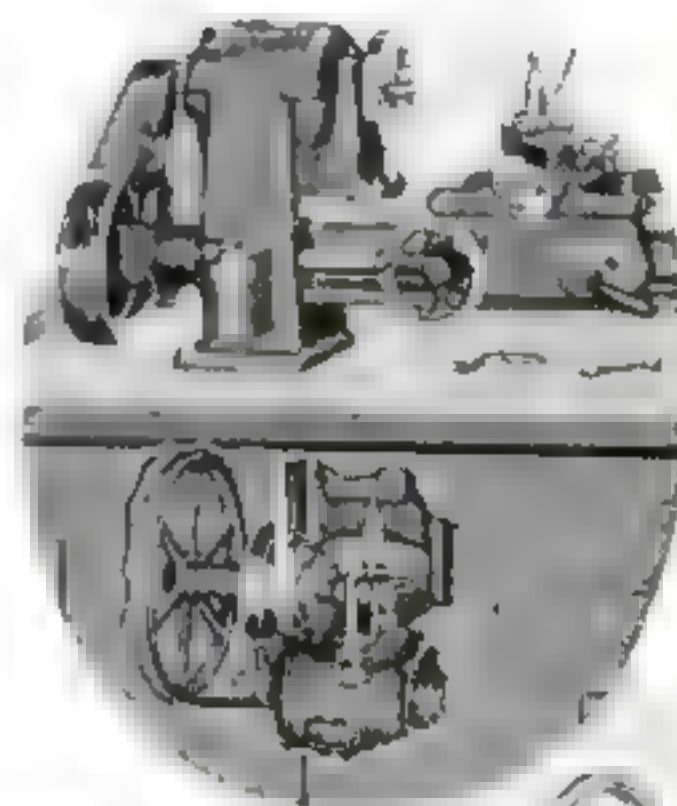
Write us for details of this liberal financing plan. Only 5% interest rate, the lowest in history of easy payment selling.

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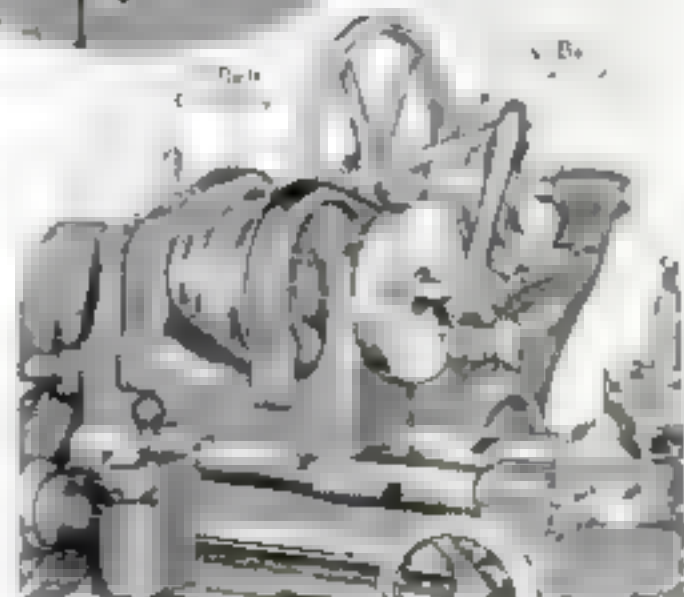
South Bend, Ind.

Other types of 9-inch Workshop Precision Lathes



9" Workshop Lathe with Underneath Belt Motor Drive. Motor and drive unit are mounted underneath bench. V-belt or flat belt drive to spindle.

V belt motor drive instead of flat belt can be furnished as an optional feature on all types of 9-inch Workshop Lathes. Full details in catalogue shown below. Write for it.



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SOUTH BEND Precision LATHES

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MY HOME TO
SMILE AT THE
NEIGHBORS

THEN BE
SURE OF THE
*color
scheme*
BEFORE YOU
PAINT

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Your nearby dealer in Lowe Brothers products invites you to see the Lowe Brothers "Pictorial Color Chart." Reproduced in *actual paint*, you will find harmonious new exterior color schemes to make your home "smile at the neighbors."

Also, there are charming color combinations for interiors which will give exactly the color effects you want to achieve. And you will be delighted to learn how easy it is to be sure of results before a brush is lifted.

What's more, you can depend upon the known quality of Lowe Brothers paints, which contain approximately 90% film-forming solids, as against many "cheap" paints which often contain as little as 37% film-forming solids—the rest being water and other evaporating liquids.

Don't take any chances. Depend upon Lowe Brothers quality to insure maximum economy and enduring beauty. The Lowe Brothers Co., Dayton, Ohio.

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PAINTS • VARNISHES
Quality Unsurpassed Since 1869

MINE EXPLOSIONS MADE TO ORDER TO DEMONSTRATE SAFETY METHODS

(Continued from page 23)

tion and covered with twenty-five pounds of coal dust. Again the magneto whirled. The dust leaped into the air in a dense cloud, and a flame flashed through it with a peculiar "whoosh." The resulting cloud of black smoke drifted away in the breeze. Similar tests sometimes are staged in one of the mine portals, to show visitors the hazard of the capping shot as compared with other methods such as placing the explosive in drilled holes.

A MAN wheeled towards one of the mine portals a coal car completely covered with a black, grimy deposit. This car, Howarth explained, has enjoyed a more exciting life than almost any other similar car in the world. Its job is to demonstrate how coal dust can be exploded with an electric arc, such as might develop when an electric cable is damaged in a mine. On the car is a trough that will hold twenty-five pounds of coal dust. Protruding into this trough is the nozzle of a compressed-air line. At the other end of the car, the tip of an insulated metal rod almost touches a part of the iron car frame, forming a gap across which an electric arc can leap.

One of the miners wheeled the car inside the mine entry. Another man brought up a car carrying cans filled with coal dust. The trough of the demonstration car was filled with this dust—twenty-five pounds of it.

"It's all right to stand here," Howarth said, indicating a place about seventy-five feet from the mouth of the mine. Then he signaled one of the men that all was ready.

The man closed a switch. This shot current across the spark gap on the car, and at the same time opened a valve that released compressed air into the coal dust, forming a dense cloud that swept over the electric arc. With a roar, the cloud, now a mass of flame and smoke, surged out of the mine, kicking up dirt and leaves.

"Now let's go inside for the next shot," Howarth suggested.

Hoping that these men had not overlooked any possible hazards in their years of work with coal dust, I followed the superintendent to a point perhaps fifty feet beyond the car. Again the dust trough was loaded, and again it was fired.

Invisible hands grasped me and shook me violently. My eardrums rattled, and my trouser legs flapped like flags in a storm. It was all over in a second. But I couldn't see a thing! The superintendent explained that the mine entry was filled at its mouth with smoke, which soon would be driven out by the current of air from the ventilating fan. In a few seconds, light crept in beneath the smoke curtain. Gradually the curtain lifted and moved outward.

BUT the test I had just witnessed is little more than a puff of smoke in comparison with the really spectacular display that results when the entire mine entry is filled with dust and exploded. A cannon 1,300 ft. long, fired at the opposite hillside! Two cannons, in fact, for a small one is used to set off the initial explosion. Many things can be tested under full-scale conditions in this mine—the explosiveness of various kinds of coal dust, pressures developed, velocity of the flame, effectiveness of dust-explosion barriers, strength of the mine walls and other structural features, and so on.

It takes the experimental mine staff a full day to load the mine for an explosion. First, all electric lines are disconnected, to prevent accidents. If a special kind of dust is being tested, the mine is cleaned thoroughly with compressed air, to remove dust formed from the coal already there. As a further precaution against dilution, the inside of the mine

entries are coated with a special cement mixture sprayed on with compressed air. This process, incidentally, was first tried out here for use in a coal mine, and is now employed widely as a means of strengthening mine roofs and walls.

During the time that the mine has been in use, some fifty different kinds of coal dust, from England and Canada as well as the United States, have been tested. The dust is scattered on the floor and on boards placed across the mine, near the roof, for that purpose. When the dust, perhaps a ton of it, has been scattered throughout the portion of the mine to be used in the test, the firing equipment is made ready. This generally is a small cannon loaded with black powder or an explosive mixture of gas and air.

OF COURSE, no one can remain in the mine to see what happens; so a complicated system of instruments has been installed for the purpose of analyzing explosions. These measure such things as the velocity of the flame, size or extent of flame, pressures developed at different points and the time intervals involved, composition of gases in the flame and before and behind it, direction of movement of air and burned gases, and time of movement of solid bodies such as parts of barriers.

Things happen so quickly that such measurements must be made in thousandths of a second. A battery of chronographs takes care of this. These are situated in the observatory, and consist of lampblack-covered drums against which celluloid fingers, including some that vibrate a known number of times each second, bear. These instruments can measure the time for twenty-seven different events occurring at the same instant. Normally, the chronographs run ten seconds in timing an explosion.

Scattered along the mine entries, at 200-foot intervals, are instrument stations housing pressure-measuring manometers. These instruments, protected by steel plates, record pressures developed and the duration of the explosion flame. A mirror, actuated by a steel diaphragm, moves a light beam that traces a path on a drum covered with photographic paper. Engineers can translate this line into the pressures existing before, during, and after the explosion. A lens, fitted into a hole in the side of the instrument case, focuses the light of the explosion flame on the drum, producing a record of flame duration.

IN ORDER to determine just how fast the flame travels, tin-foil strips are placed every 100 feet along the mine passageways. When the flame melts one of these strips, an electric circuit is broken, and one of the chronograph fingers in the observatory marks the smoked drum accordingly. The extent of the flame can be determined to the nearest 100 feet by noting which foil strips were affected; but a more accurate measurement is obtained by disks of bromide photographic paper placed at twenty-five-foot intervals. Development of these pieces of paper shows which ones were fogged by the light of the explosion. Still another way of determining just how far the flame reached is to distribute safety matches throughout the entries, and then observe which ones were ignited by the flame.

Installed with certain of the pressure-measuring instruments is a vane which swings back and forth with the movement of gases during an explosion. This movement is recorded automatically. To date, no satisfactory way of measuring the velocity of these swirling gases has been found.

There is a lot of chemistry involved in the complex reactions (Continued on page 93)

EXPLODING COAL MINE TESTS SAFETY METHODS

(Continued from page 92)

that take place when a cloud of coal dust explodes. Therefore, the engineers collect samples of flame gases with an ingenious instrument which, at the right instant, breaks a thin glass seal of an evacuated flask, and then caps it with a rubber stopper as soon as the sample has been obtained. The contents of the flask are analyzed later.

The instruments, during the 1,477 major explosions that have torn through the mine—without injuring a single person—have recorded some amazing facts which, when analyzed, produce a fairly complete picture of how mines have been destroyed and miners killed in disasters of the past.

THE initial shot of four pounds of FFF black blasting powder in the small cannon sets up a compression wave which travels through the mine with the velocity of sound, 1,100 feet per second. This wave stirs up coal dust and produces the clouds of it necessary for propagation of the flame. However, this compression wave is strong enough to throw up dust for only a few hundred feet. It is the exploding of the dust itself, involving violent agitation of the air ahead of the flame, that raises additional dust.

The flame itself may travel through the mine at only 100 feet a second, or it may move much faster. Velocities of 3,000 feet a second (thirty-four miles a minute) have been measured; the engineers believe that much higher speeds have been attained.

The flame itself is pointed in shape, with the point approximately in the center of the passageway. In some cases the point is 100 feet long, and the flame itself 300 feet.

Explosion pressures as high as 127 pounds to the square inch have been measured in the mine, following the igniting of about a half ton of pure coal dust. Higher pressures have been produced, but these wrecked the instruments, preventing measurement. Such pressures are capable of producing great damage. An interesting action observed in connection with explosions is that loose objects such as boards used for supporting coal dust are frequently moved toward the point of origin of the explosion, by the strong compressional wave that travels backward from the flame.

Repeated tests at the experimental mine have proved that coal-dust explosions can be prevented or controlled most effectively by the use of rock dust. The powdered rock material is distributed through the mine; rising with the coal dust, it forms a mixture that is incombustible. Watering the face of the mine is advocated as a further precaution.

BUT the study of coal dust is not the only research undertaken at the experimental mine. The explosives section is testing various blasting materials constantly, and has established regulations for "permissible" explosives which do not produce enough flame to ignite coal dust, or explosive mixtures of gas and air.

Among the other things studied at Uncle Sam's mine are: ventilating methods and equipment; explosions of fire damp (methane gas) by itself and in combination with coal dust; "keeping" properties of explosives stored in mines; methods of extinguishing mine fires; compressibility of coal, to determine safe sizes for pillars and abutments; strength of mine stoppings; and eliminating danger from electric sparks.

The mine is used also for demonstrating safety devices and methods, and for training men in rescue work. The ventilating system used in the Holland Tunnel under the Hudson River at New York City was first worked out in this mine.

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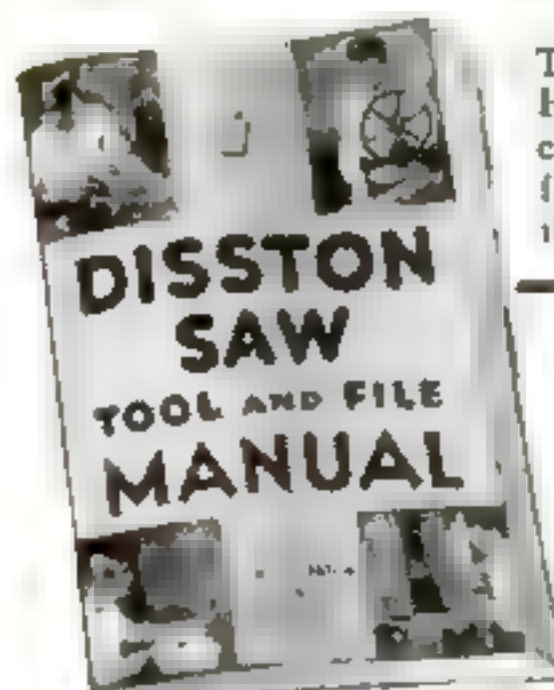
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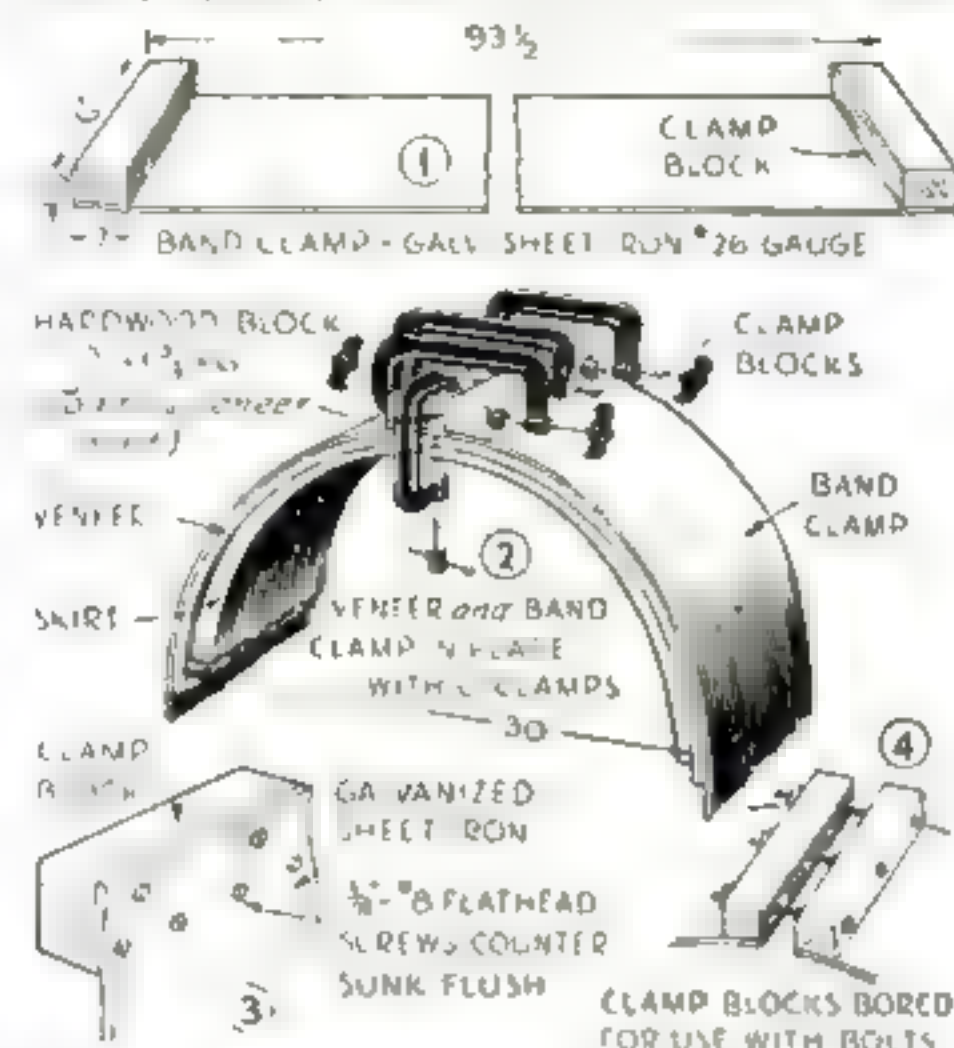
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**BAND CLAMPS SIMPLIFY
CIRCULAR VENEERING**

THE cost of any kind of regular equipment for circular veneering is prohibitive for home workshops and other small shops. The accompanying drawings, however, show an inexpensive band clamp that can be made in a few minutes. Although a different clamp is necessary for each job of a different size, it pays well to make the device because of the labor it saves and the almost perfect job that can be done with it. The method meets all requirements of the average small shop.

Let us assume that a circular table skirt is to be veneered, the outside diameter being 30 in., the circumference 94 1/2 in., and the width 5 in. Put three or more 3/4-in. flathead screws, equally spaced, in one edge of the skirt. Have



How clamp is made and used. The thickness of veneer and metal has been exaggerated to some extent to make the arrangement clearer

the heads project 1/2 in. so that when skirt is laid on the bench, it will rest on the screws 1/2 in. above the bench top.

Make the band clamp as in Fig. 1 of 26-gauge galvanized sheet iron, 3/4 in. less in length than the circumference of the skirt. Hardwood clamp blocks 1 1/2 by 2 by 6 in. are shaped to fit the circle of the skirt as shown in Fig. 3 and are attached with 3/4-in. No. 8 flathead screws, countersunk flush.

Cut the veneer 6 by 94 1/2 in., 1 in wider and 1/4 in. longer than the skirt. Apply casein or prepared liquid glue (if not equipped to use hot glue) to both skirt and veneer. Place the veneer around the skirt, the veneer extending 1/2 in. beyond each side of the skirt to allow for trimming. Drive two or more 1/2-in. No. 20 brads across the center of the veneer to hold it in place.

Apply the band and C-clamps as in Fig. 2. Tighten the center C-clamp first, taking up the slack. Then apply the other clamps, and clamp up evenly, tapping lightly over bulges or other irregularities with a rubber mallet (or use a felt sand block under the hammer) until all parts of the veneer are in contact with the core.

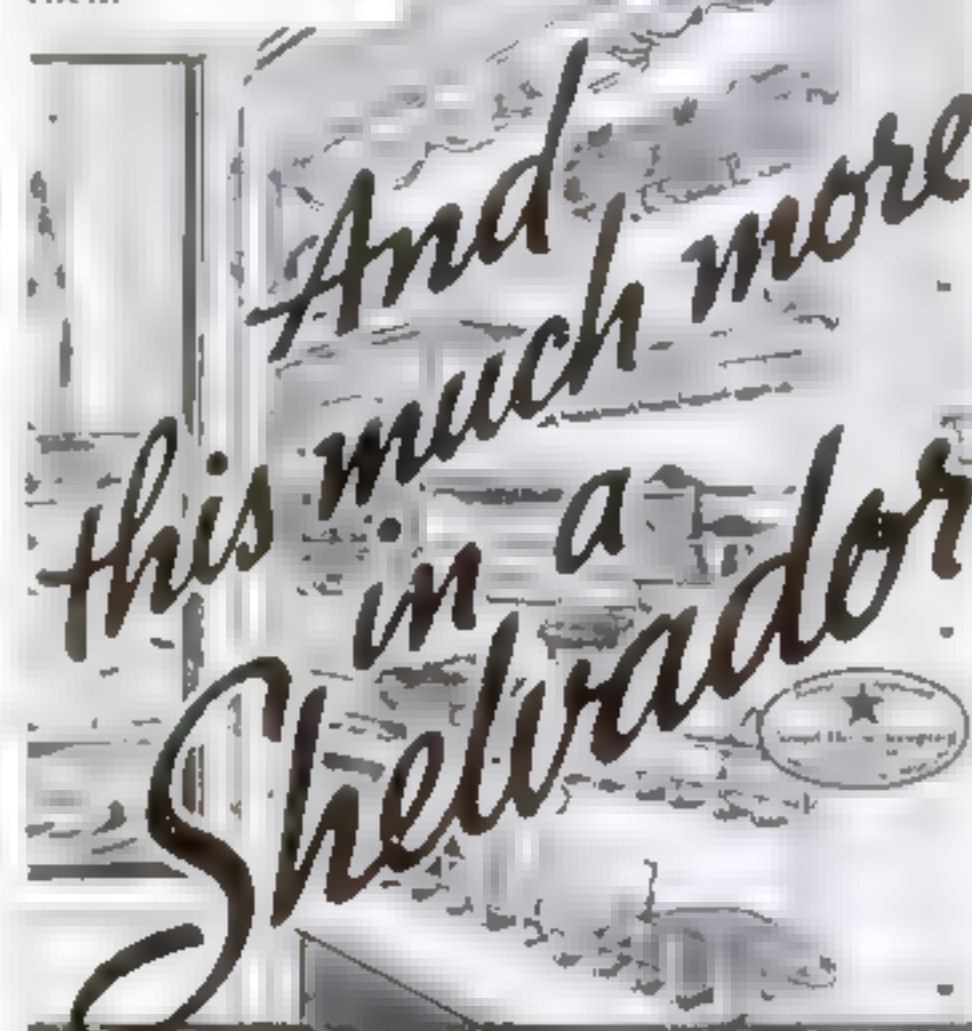
The ends of the veneer are in the space between the clamp blocks, exposed for jointing, and they lap 1/4 in. or more. With a straight-edge and sharp knife, cut straight down through both parts of the veneer to the core, making a perfect joint. Place over the joint a piece of hardwood 3/4 by 1 3/4 by 6 in. Put on pressure with two C-clamps. When the glue has set, remove the clamps and trim the veneer.

If C-clamps are not available, bore clamp blocks in pairs, as in Fig. 4, for 6 by 3/8-in. machine bolts. For faster work, make slots in the heads of the bolts for a screw-driver bit. Insert wedges under the bolts for pressure on the joint in the veneer.—R. C. STANLEY.

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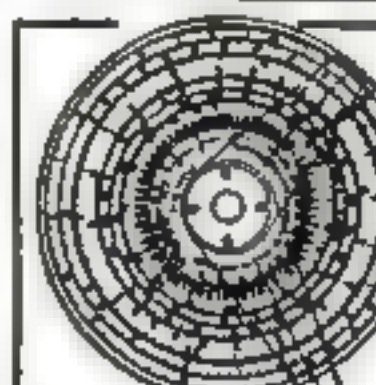
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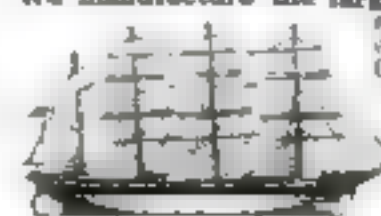
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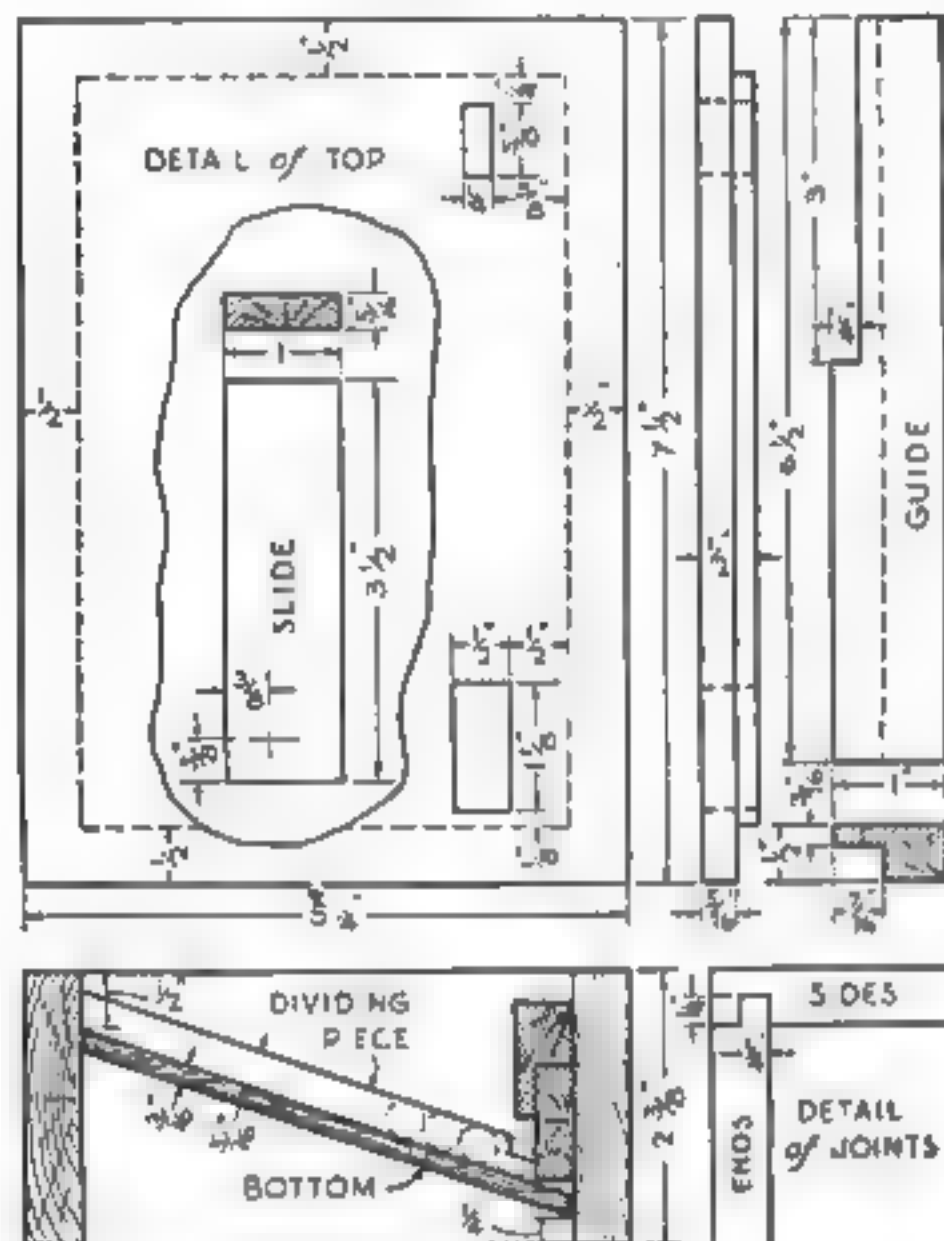
CIGARETTE DISPENSER

(Continued from page 73)

the $\frac{1}{8}$ -in. drill rod or wire that represents the fishing rod. This wire should be securely cemented in place.

The fish is scroll-sawed from $\frac{1}{2}$ -in. wood, a $\frac{1}{4}$ -in. groove is cut in the bottom, and a $\frac{1}{8}$ -in. hole is drilled for the fishline. The pulley is turned from hardwood and is pivoted with a brad in line with the $\frac{1}{8}$ -in. hole. The pivot piece for the fisherman and the fish can now be glued in place.

The slide and the guide are sawed to shape, and the guide is nailed or screwed to the side-piece of the box as shown. A small screw to which the line is attached is placed in the slide in the position indicated. A $\frac{5}{16}$ -in. hole through which the cigarette is to be ejected is now drilled. The box is then glued



The box top, sectional view of the box, and details of joints, cigarette guide, and slide

together. A small tack is driven into the slide and another into the bottom of the box, over which a small rubber band is slipped to return the slide after each stroke. The dividing piece must be cut to fit, and it may be necessary to cut a rabbet at the bottom to allow clearance for the tack in the slide.

A heavy piece of fishline is tied to the screw in the slide, passed around the pulley, carried up through the hole in the fish, and tied to the fishing pole. The magazine is filled with cigarettes and the ejector tested. It may be necessary to enlarge the ejector hole.

The fish heads are cut from 1-in. wood, and a $\frac{3}{8}$ -in. hole is drilled in the head that covers the ejector hole. These are glued in place.

A dark brown, varnished surface is best for the box. The fish are painted a light green with red mouths, black eyes, and black-trimmed fins. The fisherman's suit is white, face pink, mouth red, and hair, hat, pole, suit trimmings, and the outline of his eyes and ears are black. The whites of his eyes are pure white.

WATCH ADJUSTED ACCURATELY WITH AID OF MICROMETER

A WATCH may be adjusted with great accuracy if machinists' micrometer calipers are available. After removing the back from the watch, place the micrometer in such a position that when it is adjusted to close, it moves the regulating lever to fast or slow (whichever is desired). This method will not damage the micrometer in any way. If the watch is checked with radio time signals, it can be adjusted very accurately.—E. F. TROUP.

Insulating Spark Plugs Against Electrical, Mechanical and Heat Shock

No spark plug is better than its insulator, and incidentally no engine is better than its spark plugs. The function of the insulator is to prevent the high tension current from flowing in any direction except across the gap, formed by the two electrode wires. At this point, the current, in the form of a spark, ignites the combustible gas in the cylinder at the instant of highest compression.

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PLASTIC WOOD

BOWL HOLDER DESIGNED LIKE BRAZIER

(Continued from page 66)

starting to glue up, take these precautions: First, see that the dowels are small enough to slip freely in and out of the holes when wet with glue. Next, see that they are a little shorter than their holes, so that there is no danger of their touching bottom. Finally, have ready some clamping device to go around the edge of the frame. A good method is to use a heavy leather strap or strip of webbing with blocks nailed to the ends so that they may be gripped with a hand screw. Test it beforehand, to be sure that strong pressure can be applied before the blocks come together.

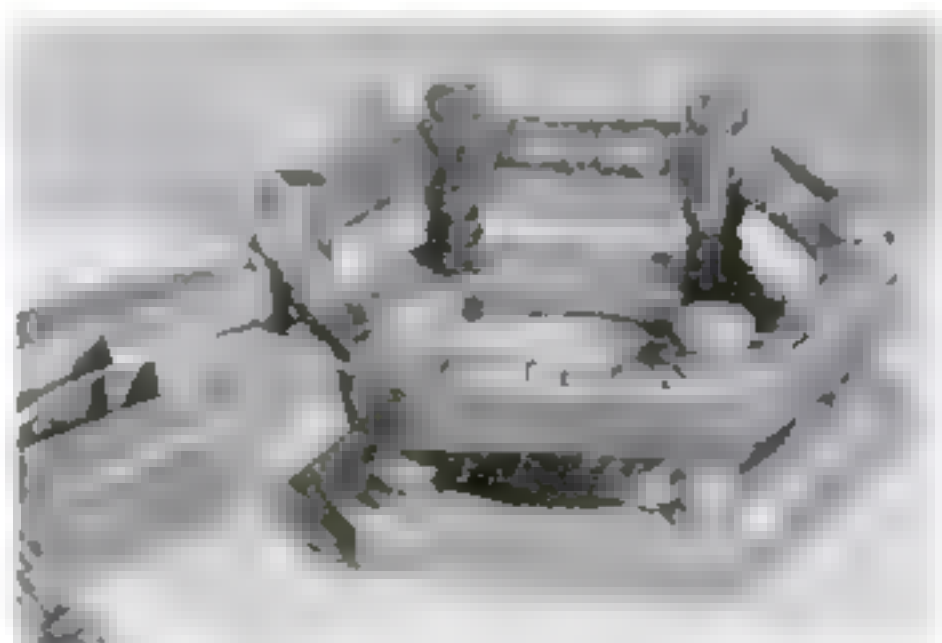
Hot glue congeals too quickly for the simultaneous gluing of so many joints; use casein or liquid glue. Having coated the dowels and the insides of the holes, insert the dowels and quickly assemble three pieces in the hands, forming a half frame. Make the other half, put the two together, and apply the clamp. Remove all squeezed-out glue very carefully, for any remaining on the surface when the finish is put on will show through as a light spot.

Now turn the spindles. Three legs can be made from one piece, the stick being planed to size and accurately centered in the lathe. When cutting the ends of the square sections, nick them with the point of a skew chisel as they turn at high speed, and finish with a hack saw rocked down against the work from the rest, which will prevent splintering. Then round the corners back, as detailed.

The same suggestions apply to the stretchers, except that the blanks should be squared to the largest diameters for turning, the ends to be trimmed to size after the other shaping is done.

Smooth the top frame, jig-saw the center to fit the bowl, and bore the holes for the leg dowels.

While the drawing gives dimensions for stretcher lengths, it is best to get them directly from the piece, since there may be a little variation in the leg thicknesses or their



A stout leather or webbing belt, with blocks nailed at ends, aids in clamping the joints

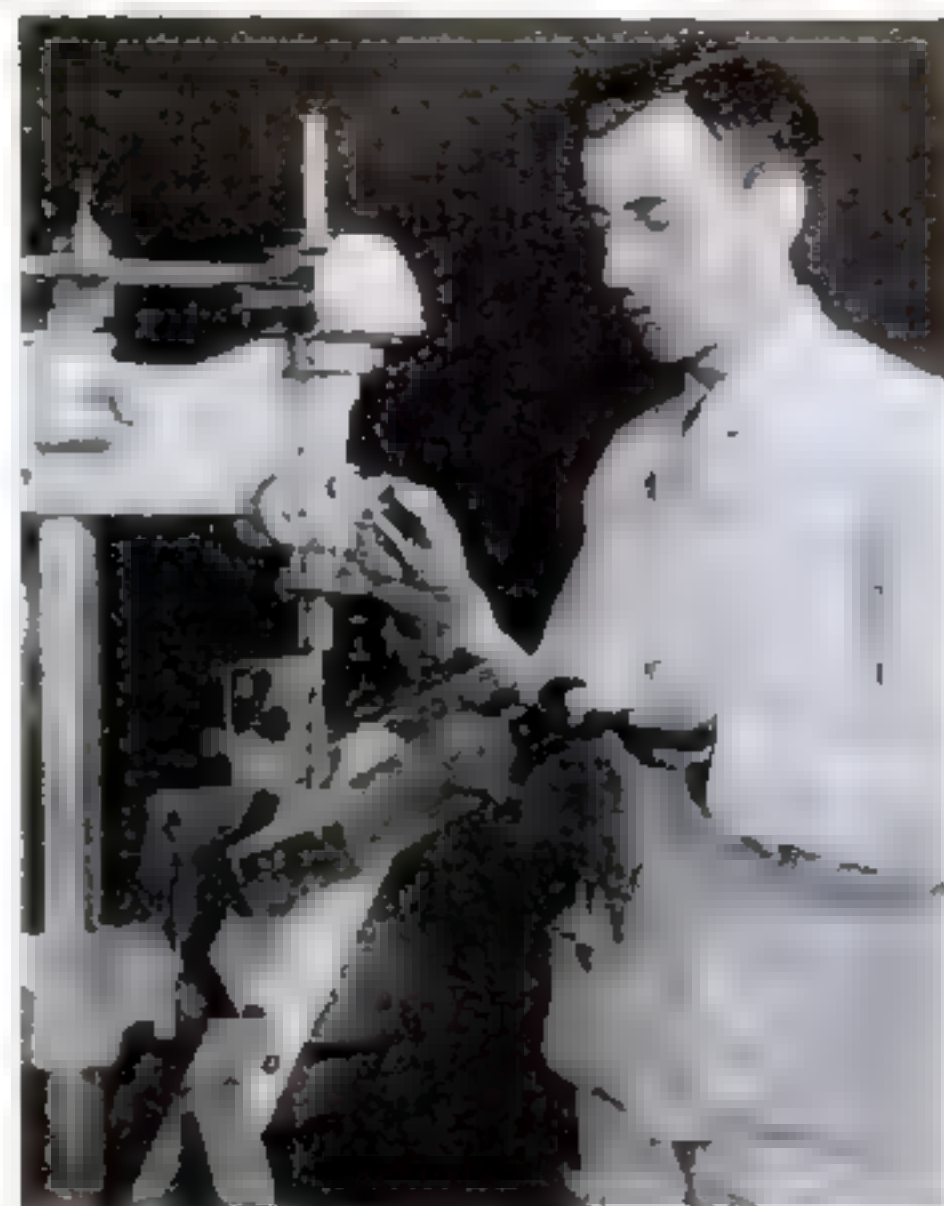
placing. Insert the leg dowels in their sockets and brace the legs with wooden strips nailed across the feet. Then number the parts so that they can be replaced without shuffling, and mark the stretchers to correspond. When marking them for length, remember that they are set back a little from the square faces of the legs.

Bore the dowel holes and assemble the stand, taking the same precautions as with the top frame.

As a final step in smoothing the stand, rasp off the upper arrises or sharp corners between the joints until at the centers the roundness is of about $\frac{1}{4}$ -in. radius. This softens the plain square edges and gives the effect of having been worn down by much handling.

The mallet is a simple turning job, with the dowel made on the handle.

The best way to finish this piece is to antique it. A fine effect is obtained by apply-



With this set-up, dowel holes may be bored accurately in the ends of the frame rails. Note the slip fence, which spaces the holes. The work can be held in the hands, if care is taken, with somewhat speedier handling

ing a thin coat of white shellac, which is lightly rubbed with fine steel wool when dry. Fill with a mixture of furniture wax and pumice stone, which gives a lighter color in the pores than the usual rottenstone, and rub off across the grain. Use string to remove excess filler from the V's in the turning, and pick it out of the corners with a sharpened match stick. Apply another coat of wax and polish with a soft cloth.

A hand-hammered brass bowl, almost hemispherical in shape, with a heavy projecting rim is just the thing to set in this stand, but an inexpensive commercial dish will do very well. In fact, for flowers you can use a tan-enameled wash basin costing fifteen cents, for it is hardly seen at all.

If the little brazier is to be used for nuts, obtain large round furniture or upholsterer's nails in dull brass finish and drive them into the top joints for anvils to crack the nuts on. Also cap the mallet faces with them, thereby preventing the wood from becoming battered.

WORKBENCH AND DESK

(Continued from page 67)

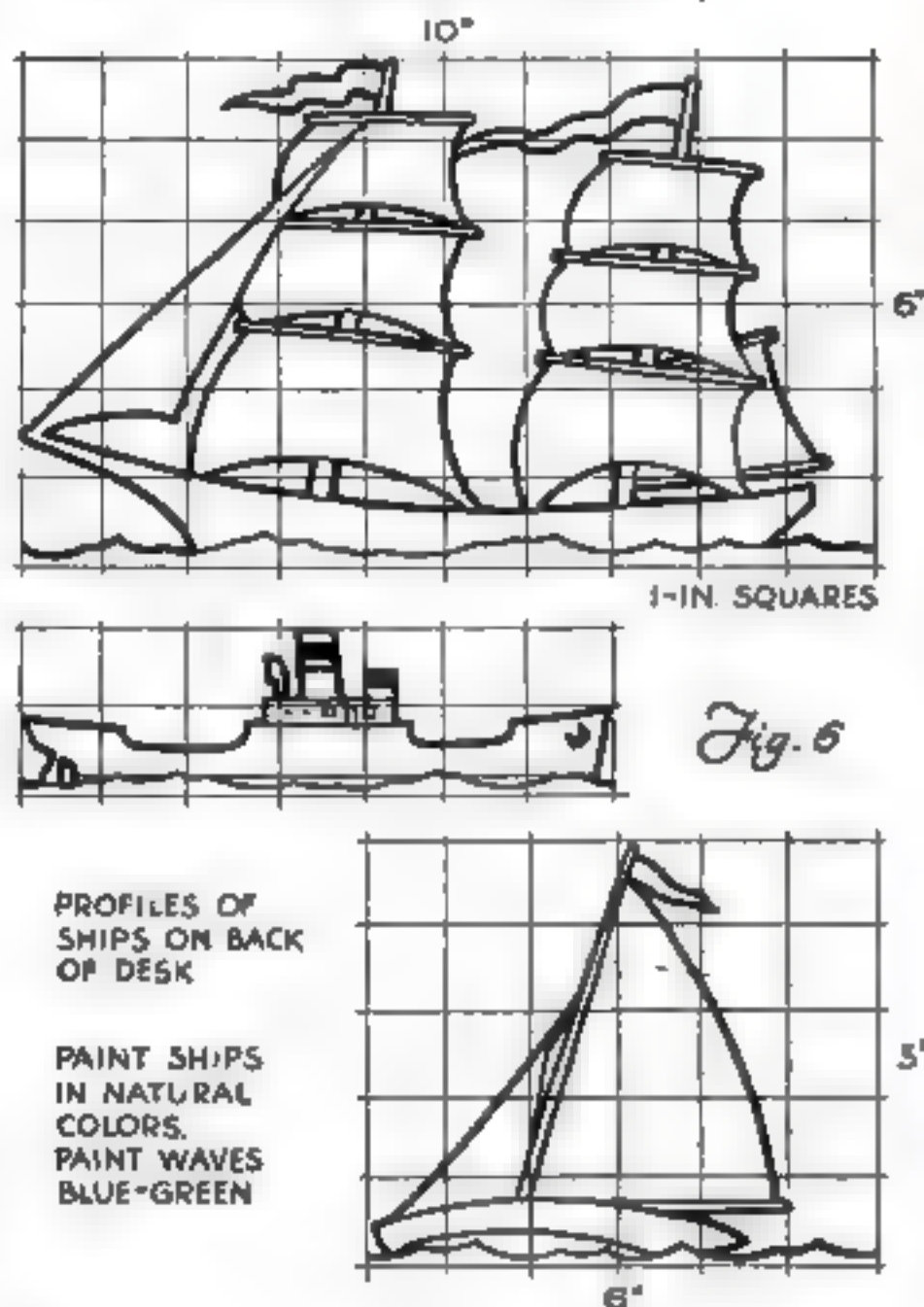
ings are brushed after the day's work, permitting the top to be turned down flat. This method of disposing of shavings will be appreciated as much by mothers as by young craftsmen.

At the right end a panel opens to disclose a tool rack as well as horizontal compartments for long balsa sticks, which so often become broken when not properly stored away. Bamboo paper and sheet balsa are also provided for here. As the compartments are long—the full length of the bench—a novel arrangement is provided for pulling out short pieces which slip back in the pigeon-hole. This consists of a block that fits loosely in the compartment and to which a long wire is attached.

General dimensions are given in Fig. 1, and constructional details in the cutaway perspective, Fig. 2. Note that two of the legs on the left are 2 by 2 in. (net), and the pair on the right are full 2 by 4 in. in order to make room for the tool panel illustrated in Fig. 3. The four legs are tied together at the top with rails to which the workbench top is screwed, as indicated in Fig. 2. Mortises and tenons reinforced with glue are used for the principal joints. (Continued on page 97)

WORKBENCH AND DESK

(Continued from page 96)



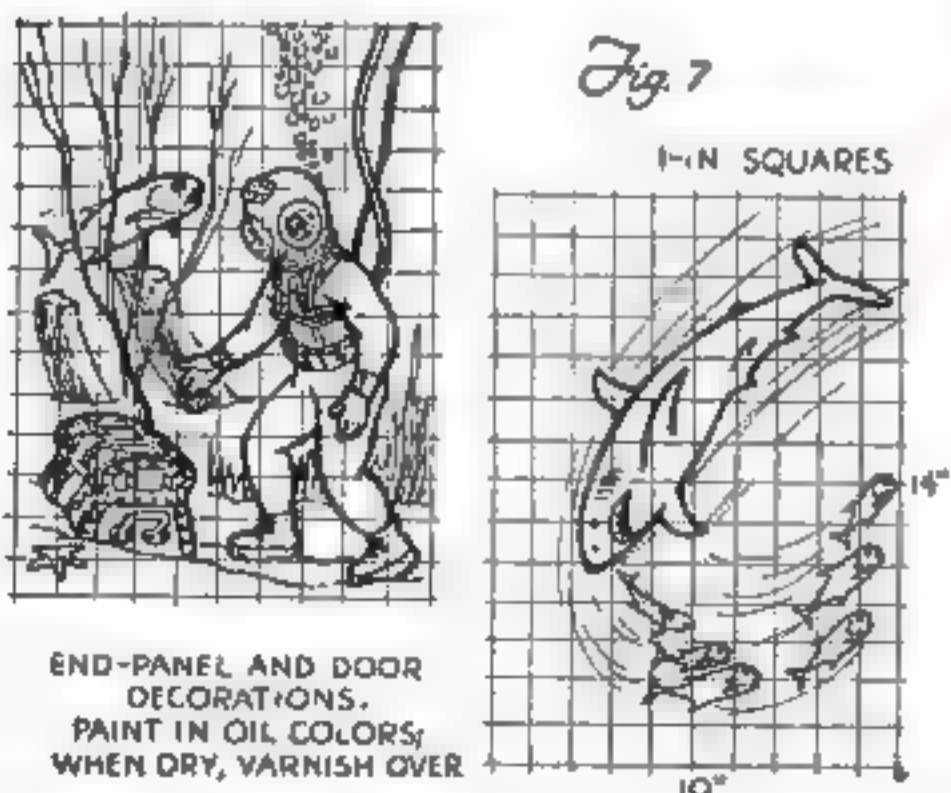
The plywood panels are set into rabbets. The hinged desk lid is a single piece of $\frac{1}{2}$ -in. plywood, held up by a folding stay or bracket on the left end. When the lid is up, blueprints or plans can be thumb tacked on the underside.

The pencil boxes are shown in Fig. 4. These swing on a pin at one end, and the toppiece is installed after the box and pin are in place. Receptacles for ink bottles are provided in the center.

In Fig. 5 is shown the drawer which slides under the shaving well. Note that the end is inclined so that removal of the last scrap of shavings is made easy without turning the drawer upside down. A forward compartment in this drawer is reserved for tools.

The ornamental ships are scroll-sawed from $\frac{1}{2}$ -in. plywood. They can be cut separately from the panel which supports them and then glued in place. The profiles are given in Fig. 6. After they have been cut, touch them up in realistic effect. Use a bluish white for the sails, and add colored pennants and brown rigging. The hull of the square-rigger may be black with a white molding.

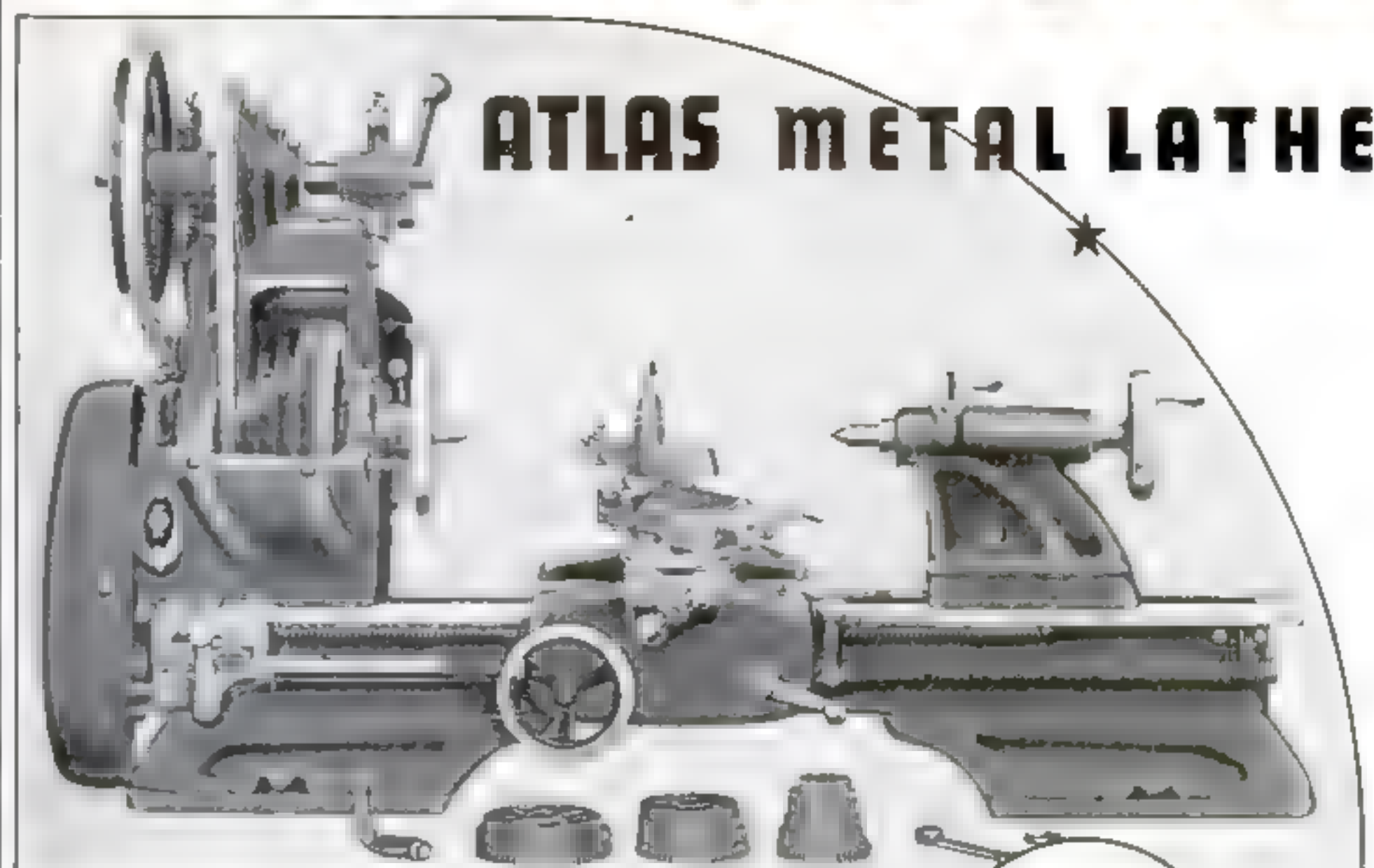
The end panels of the desk will be enhanced by painting on a marine scene, such as illustrated in Fig. 7. If you do not feel that your artistic ability is equal to these, cut out some colored illustrations from a magazine and glue them on the wood; then apply a coat of varnish.



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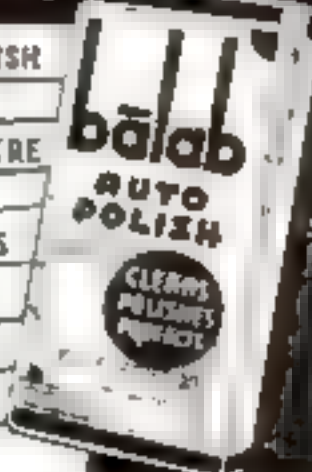
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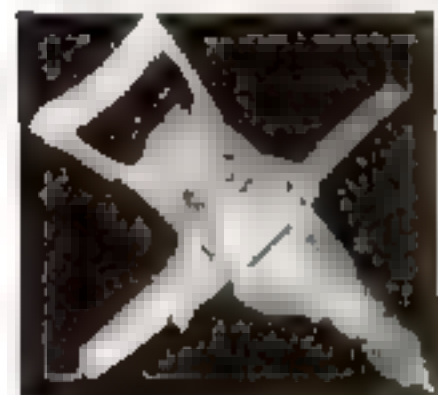


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MAKING A LIE DETECTOR

(Continued from page 63)



The rubber arm band and its cloth envelope, and how they are applied to the upper arm

rubber diaphragm and cause a movement of the indicating hand, this being recorded on the paper tape.

Ordinary adding machine paper can be used for the tape, the roll being supported on a dowel as shown. Another dowel, which ends in a knob outside the box, is used as a take-up spool. As each question is asked, the knob must be turned slowly and uniformly. The paper could be made to unroll automatically by means of a spring or electric motor placed inside the box, but this would, of course, make the construction more complicated.

One illustration shows the band which is wrapped around the upper arm of the person undergoing a test. A rubber bag is made from a piece of automobile inner tube long enough to reach around the arm. Cemented into one side is the end of the rubber tube from the indicator box, and into the other side is connected the bulb from an ordinary atomizer. Sew the bag into a cloth envelope with tapes attached so that it can be tied in place. Squeezing the atomizer bulb will inflate the bag and cause pressure around the arm. The subject's own blood pressure or pulse will cause fluctuations in the air pressure, these being recorded on the tape as illustrated.

Probably you have observed that, when excited or frightened, your perspiration glands will become more active, this being most noticeable in the palms of the hands, which will sometimes become quite moist. Another type of lie detector, known as the psychogalvanometer, takes advantage of this fact, and with it you can carry out the same experiments suggested heretofore. It is very sensitive, despite the relatively slight increase in perspiration that occurs when a person tells a lie.

An electrode is grasped firmly in the palm of one hand, and two wires lead to a galvanometer through an ordinary dry battery and 6-volt rheostat. Normal moisture of the hand will allow a slight current to pass, so the rheostat is adjusted until the galvanometer needle rests at zero. You are then ready to shoot questions at the subject. The meter will remain unmoved until the subject tells a lie, when his perspiration glands will immediately become more active, allowing more current to pass through the electrode. Instantly the galvanometer needle will swing around, and with this visible evidence before him he will be forced to confess that he was fibbing about the answer to your last question.

You can make (Continued on page 99)

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FREE: Folder on Rifles, Pistols, Etc.
Hudson Sporting Goods, P-52 Warren St., New York

\$4.95

MAKING A LIE DETECTOR

(Continued from page 98)



As the blood pressure varies, the recorder makes a diagram like this on the paper tape

the galvanometer from a good compass by wrapping a hundred or more turns of fine enameled wire (such as No. 40 from the secondary of an old spark coil) around it, on the same plane as the needle. Connect the ends to a piece of lamp cord, wiring the circuit as shown in the diagram. Test it by turning the compass until the needle is parallel with the coil; then passing a slight current through the wire should deflect the needle so that it is at right angles to its former position.

In order to make the apparatus appear more complicated and mysterious, the author used the mounting illustrated in a photograph



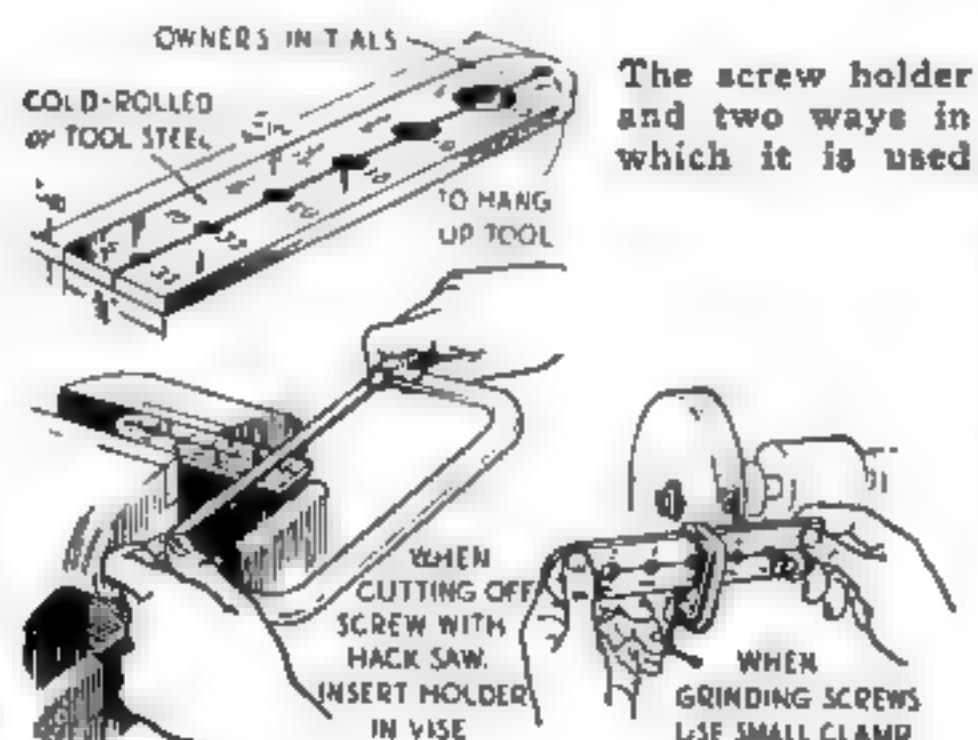
Wiring diagram for the psychogalvanometer type of detector. A is the hand electrode, B the sensitive galvanometer, C the dry cell or cells, and D a 6-volt type of toy rheostat

at the opening of this article. This is merely three wooden disks glued together and varnished, the meter being set in the upper one. Plain copper wire was wound around the top disk for the sake of appearances, although it has nothing to do with operation of the meter.

The hand electrode is a 1/2-in. wood dowel with two enameled copper wires wound, parallel to each other, around the outside. The enamel was then scraped from the outside, leaving the wires insulated from each other but allowing them to be "shorted" by contact with a moist surface.

To keep the sensitivity of this type of lie detector at the highest point, the hand holding the electrode should be wiped with a handkerchief occasionally and the rheostat adjusted each time this is done.

PLATE GIVES GOOD GRIP ON SMALL SCREWS



SMALL screws and bolts can be securely held by the method illustrated while any operation is performed on them. The holder is either cold-rolled or tool steel, about 4 1/2 by 3/4 by 1/8 in. Holes should be drilled for the screws most commonly used about the shop. After the holes are drilled and tapped, the tool should be slotted through the center with a hack saw. One advantage of the tool is that the amount to be removed when grinding or sawing is easily adjusted.—R. C. D.

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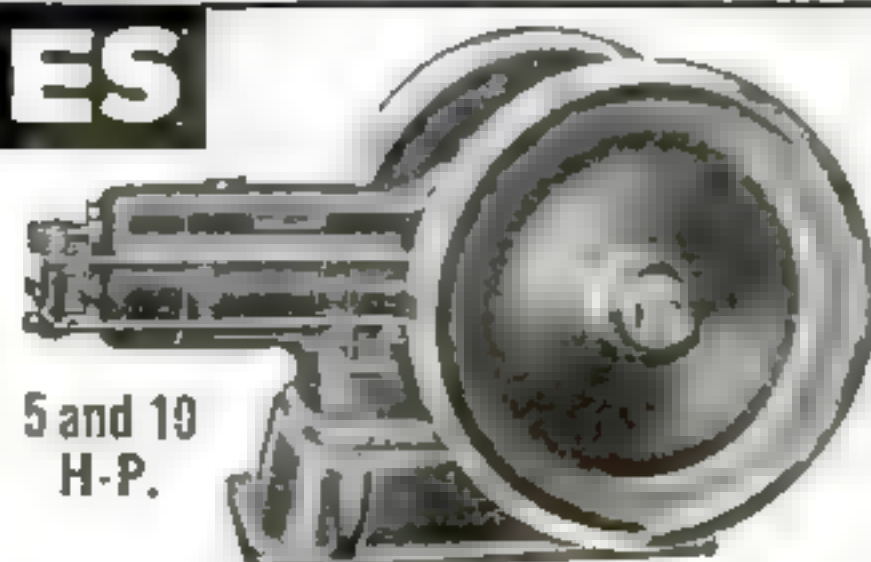
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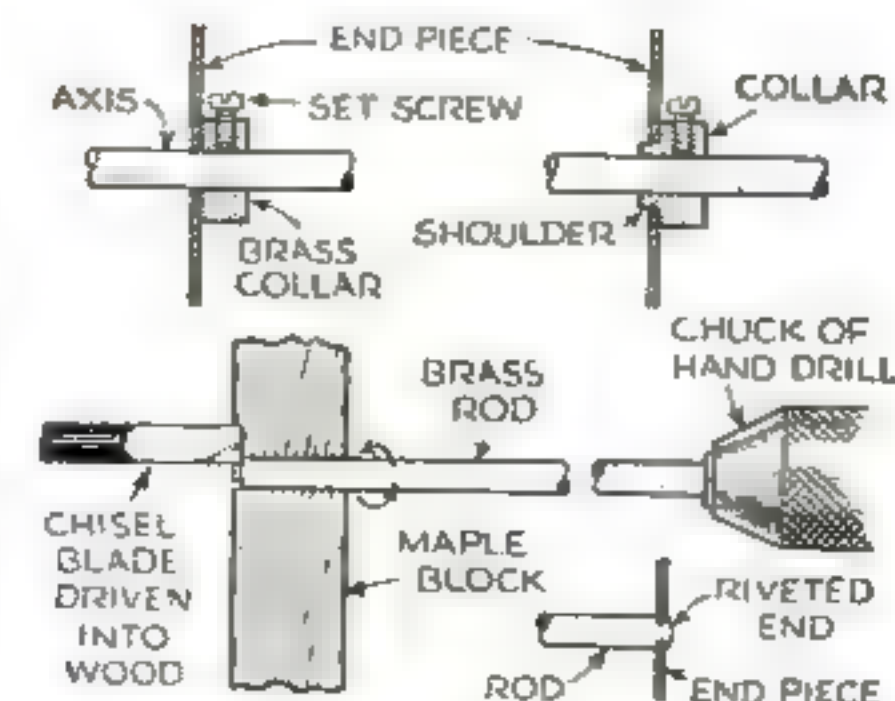
The blower end, showing one of the two reel supports, the heater unit, fan, and air filter

BOX FOR DRYING FILMS

(Continued from page 76)

box behind the fan is fitted with an air filter made by sandwiching fairly fine steel wool between two pieces of copper or galvanized screen wire. A frame, made by bending a 3-in. strip of galvanized sheet iron or sheet copper into the shape of a square U, and then cutting 90-deg. notches and bending it into a rectangle, holds the wire and wool. When the filter unit is completed, spray the wool with a small quantity of thin oil, such as that used for household lubricating purposes. Its purpose is to cover the wool and capture any dust particles.

The filter frame is held in place by strips of 1-in. wide sheet metal bent at right angles along the middle. If the frame fits the box snugly enough, it (Continued on page 101)



Assembling the reel; drawings of two types of axle collars; one way to turn the rod ends

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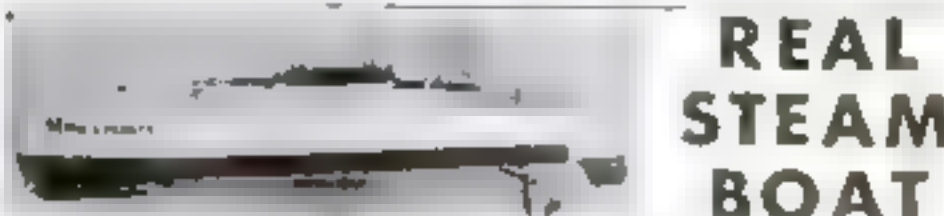
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Stuffing steel wool into the air filter. The frame is then closed and installed in the box

BOX FOR DRYING FILMS

(Continued from page 100)

will rest against the bent-over ends of the box, so that only two or three metal strips on the other side will be necessary. Cracks around the edges can be sealed with adhesive tape.

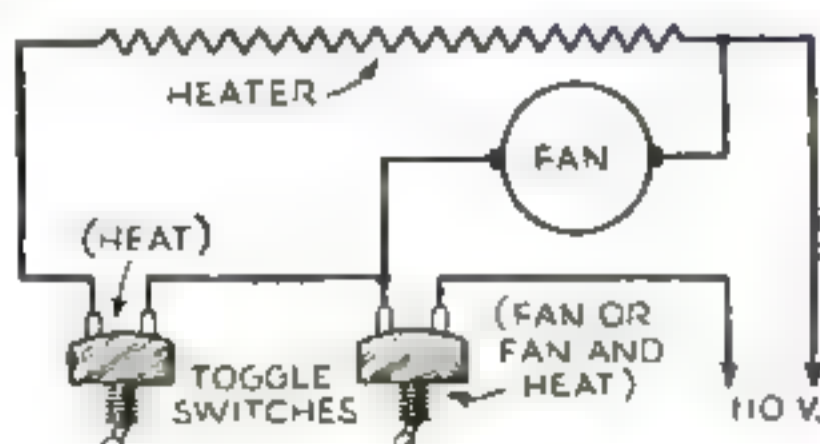
The other end of the box is covered by a sheet of screen wire held in a frame made of strips of sheet metal approximately 1 in. wide by bending them over and flattening them about the wire edges. It is held in the box by bolts or metal strips.

The box illustrated at the beginning of the article has a reel for holding motion-picture film. Ordinary roll film cannot be handled on such a reel because the gelatin back coating would be scratched by the rods. It is better to cut such film into short lengths and hold them with clips, which can be made from snap clothespins.

The reel, 9 in. long and 5 in. in diameter, is made from 3/16-in. brass rods and two sheet-metal disks. The disks have holes cut in them to permit air to reach the inside of the reel easily. These disks can be cut from copper or aluminum, or obtained by tearing apart an 8-mm. motion picture film reel of 200-ft. capacity.

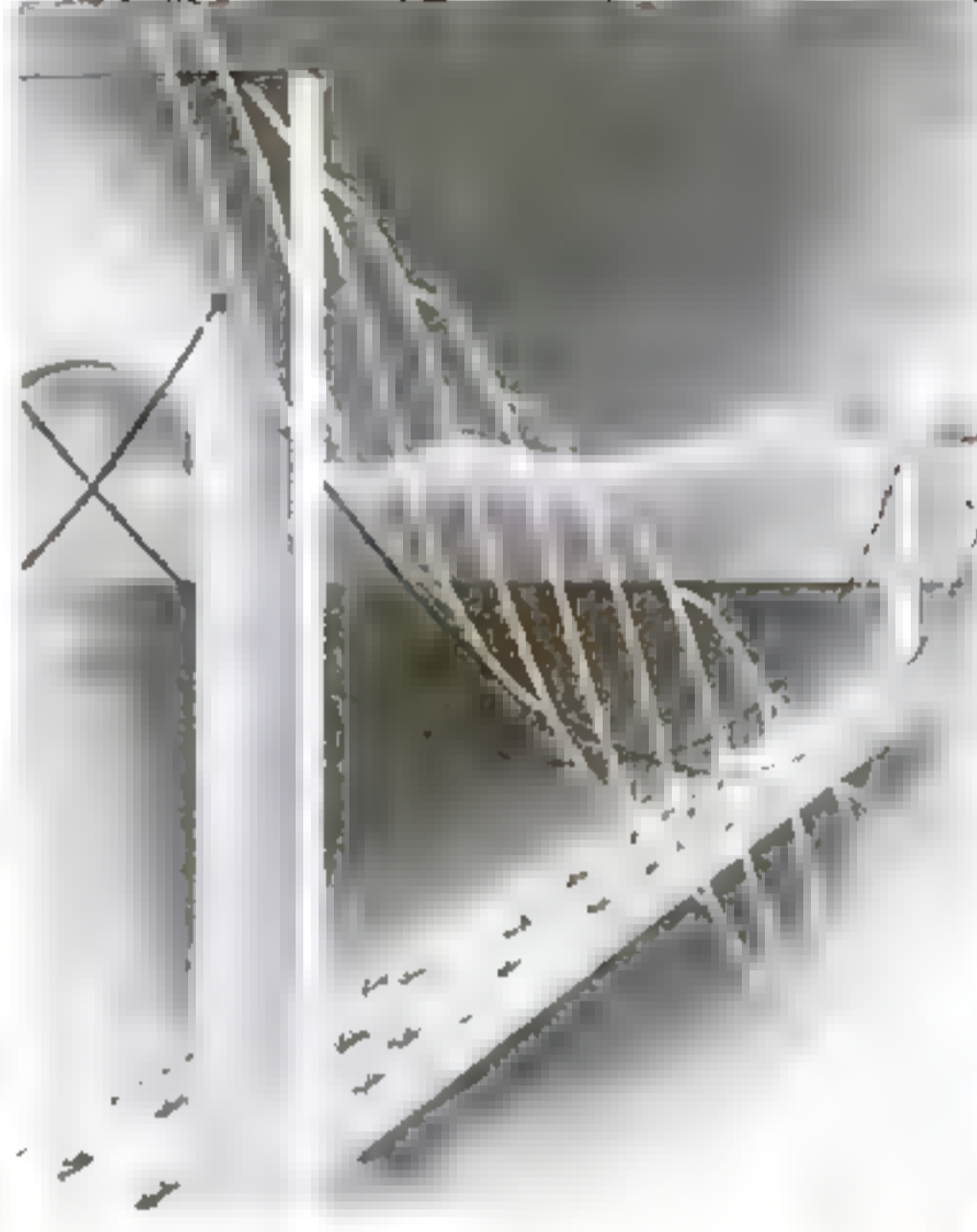
Drill eight equally spaced 3/32-in. holes around the disks, 1/4 in. from the edges. Cut the brass rods slightly more than 9 in. long. Turn down the ends so that a shoulder is formed and the diameter is reduced to 3/32 in. This can be done on a lathe, or with a jig made by drilling a hole through a block of maple and mounting a chisel or other cutting tool over the hole, where it will scrape off some metal. The rod is then held in a drill chuck, passed through the hole, and rotated against the blade.

The rods are riveted in place. A 10 1/2-in. length of rod passes through the centers of the disks to form the axis of the reel. Set-screw collars hold this rod in place. The ends of the film strip are clamped to the reel with spring clips, such (Continued on page 104)



The wiring diagram. A time-limit switch may be added, if desired, as an extra convenience

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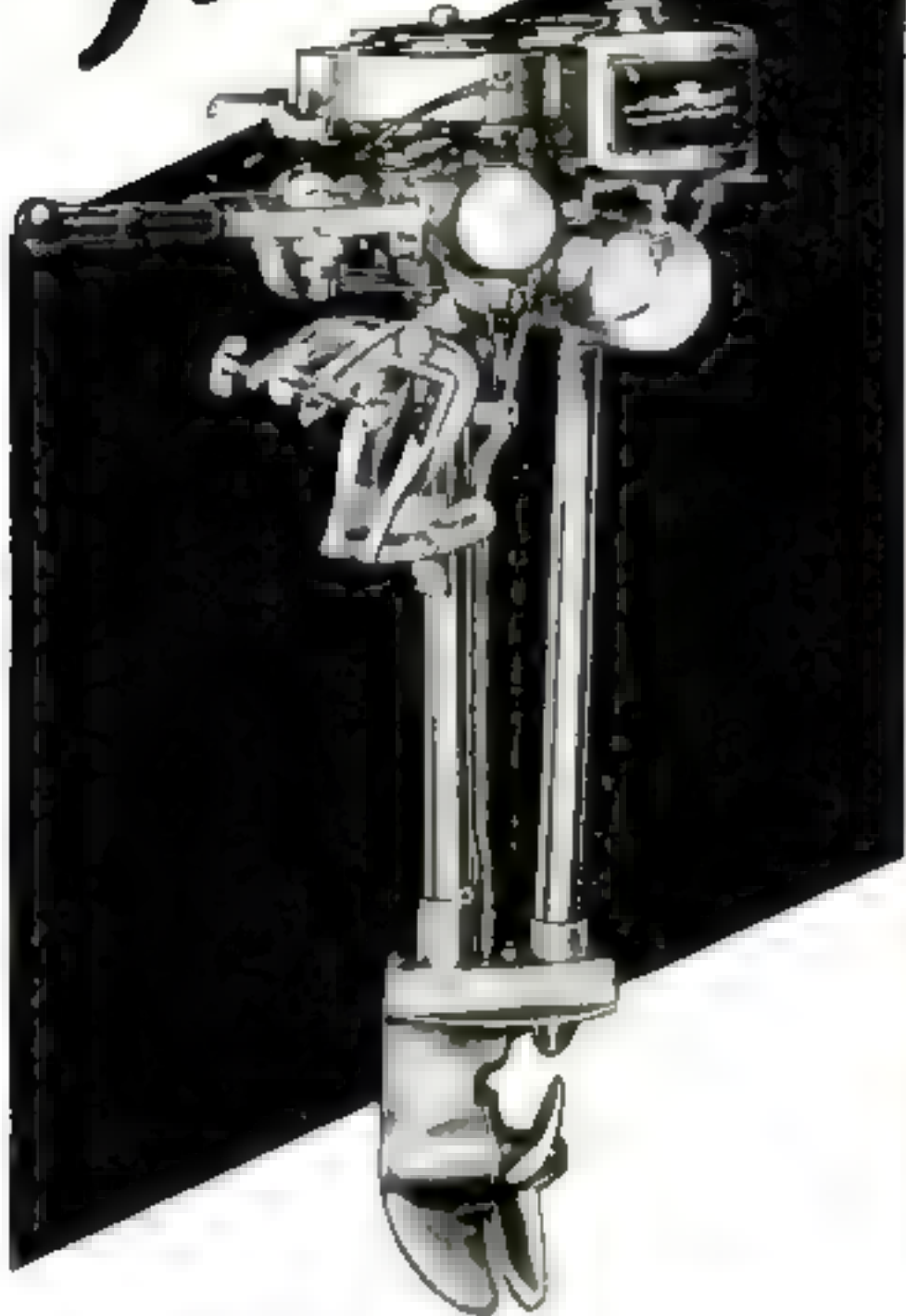
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JOHNSON Sea-horse
OUTBOARD MOTORS

BOX FOR DRYING FILMS

(Continued from page 101)

as the small-size battery clips obtainable at radio and electrical stores. The ends of the center rod rest in notches cut in the upper ends of two uprights spaced about 9 1/4 in. apart. The uprights shown were made by brazing 4 1/4-in. lengths of 1/4-in. brass pipe to round plates originally intended as covers for electrical connection boxes. A more easily



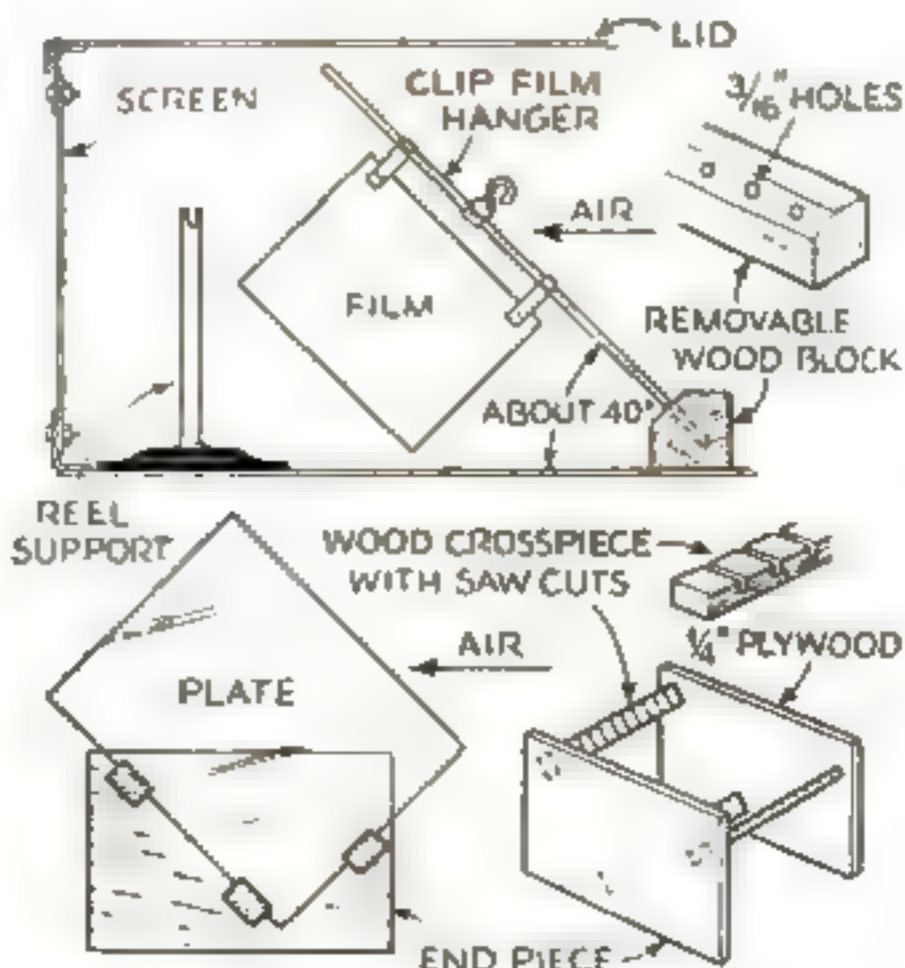
Frame-type cut-film hangers are placed at an angle with their notched ends resting on a frame made of brass rods. The frame is inclined so the water drips off better. This box, by the way, is an earlier one made by Mr. Burton and differs in trifling details

made upright consists of a length of threaded 1/4-in. pipe screwed into a small crowfoot of the type commonly used in electrical fixture work.

If glass plates are to be dried, a simple rack made of two or three notched wooden strips, running crosswise the box, will hold them. Other crosspieces can be arranged to hold the various kinds of cut-film hangers generally employed by photographers; or the film can be grasped with snap clothespins or non-corroding metal clips, which can be obtained from photo-supply dealers. Be careful not to get the films so close that they will touch each other when they curl during the drying process.

Finish the box, framework of the filter unit and end screen, and any other part that is likely to rust, with a suitable lacquer, enamel, or aluminum paint.

This box will dry a 35-mm. miniature camera film, 5 1/4 ft. long, in from five to eight minutes.



Suggestions for making holders for various purposes, all interchangeable with the reel



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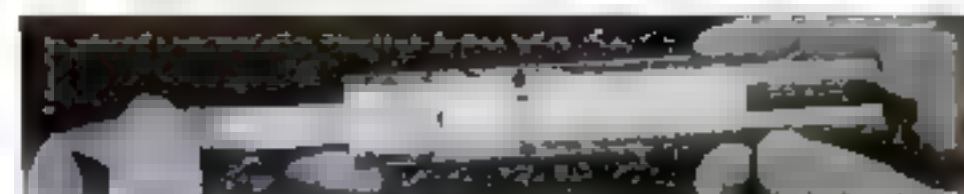
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MARIONETTE PROPERTIES

(Continued from page 71)



This view illustrates one way to make a garden scene attractive. Note the window box. The foliage is genuine fern and paper moss.

shown in the photograph of a formal garden set are flat disks covered with green paper pasted on and lined with darker color, and a few rosette flowers are added (see Fig. 5). The decorative hedge foliage is made in the same way.

An irregular circle of sheet tin (Fig. 6) forms the pool in this set. It is outlined on the edges with small stones, pebbles, and thin green moss. The fountain is made of various shaped boxes and reels glued together, all silvered and draped with Christmas tree tinsel.

The bird bath consists of two round box lids glued together on a cotton reel, then covered with pasted paper and painted (Fig. 7). A round mirror set in the bowl resembles water and reflects the paper birds.

The coloring of this set is brilliant. The trees, leaves, and hedges are sapphire blue outlined in black; tree trunks, violet; flower rosettes, cerise; all against a silver screen background. This threefold screen is covered with Chinese silver paper. Put paste on the screen, not on the paper, to prevent the screen from being pulled out of shape.

Stained glass windows, which are often necessary for settings of certain periods, are easily made of architects' tracing paper. If the outline of the design is painted with waterproof ink, the colors can be added in the spaces. The black ink outlines give the appearance of leaded glass.

Palm trees (Fig. 8) are made with paper tubes for trunks, a cork being inserted in the top. A 2-in. wide strip of tan crêpe paper is wound diagonally around the tube. A dozen or so wires are cut the length of the leaves, and long slashed leaves of green crêpe paper are folded over and pasted on the wires, the ends of the wires are pushed into the cork, and the leaves are then bent into the required shape. Another cork can be pinned to the floor of the stage and the tube trunk slipped over it.

Peach trees are made of branches dipped in glue and then rolled in wheat flakes, dyed pink. Care must be

(Continued on page 104)

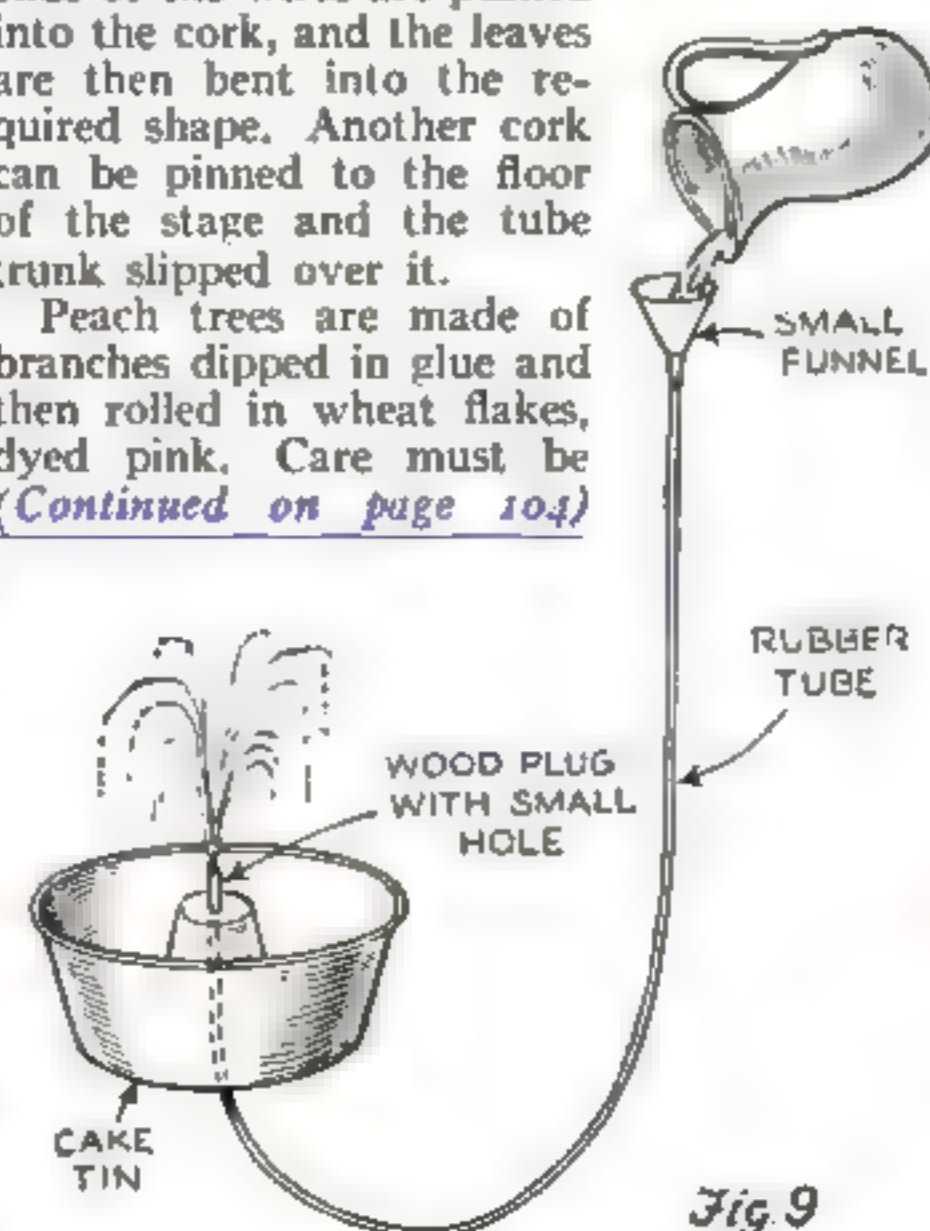


Diagram showing how to arrange a fountain that will surprise the audience by working

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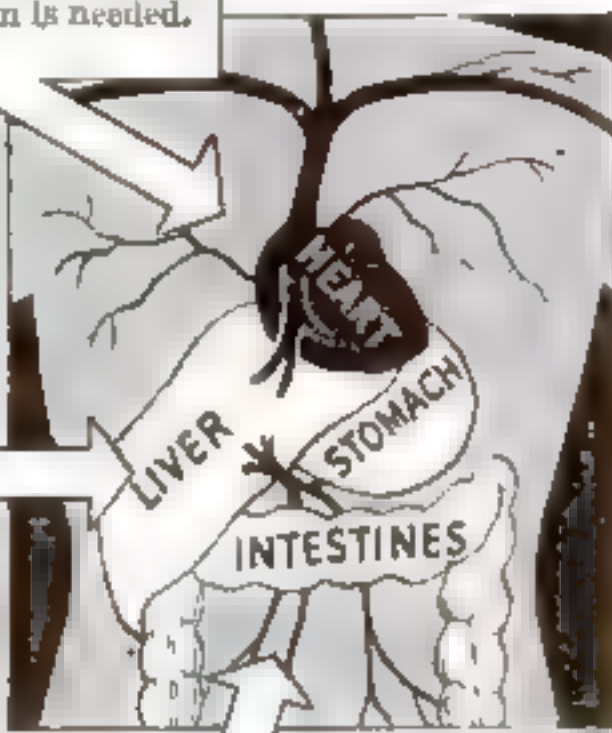
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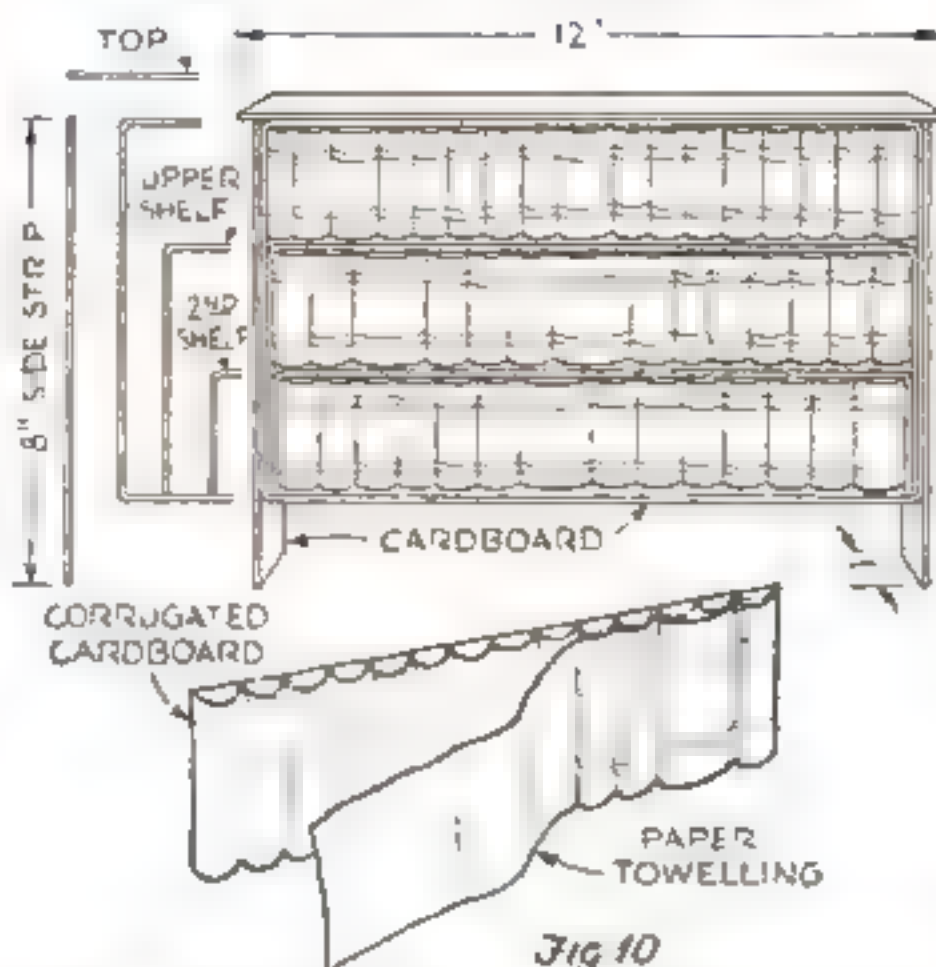
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Posed by professional models

MARIONETTE PROPERTIES

(Continued from page 103)



A suggestion for a bookcase. The backs of the "books" are painted to resemble bindings

taken, however, that they be placed where puppet strings do not catch. Yew trees are constructed of sponges, dyed green.

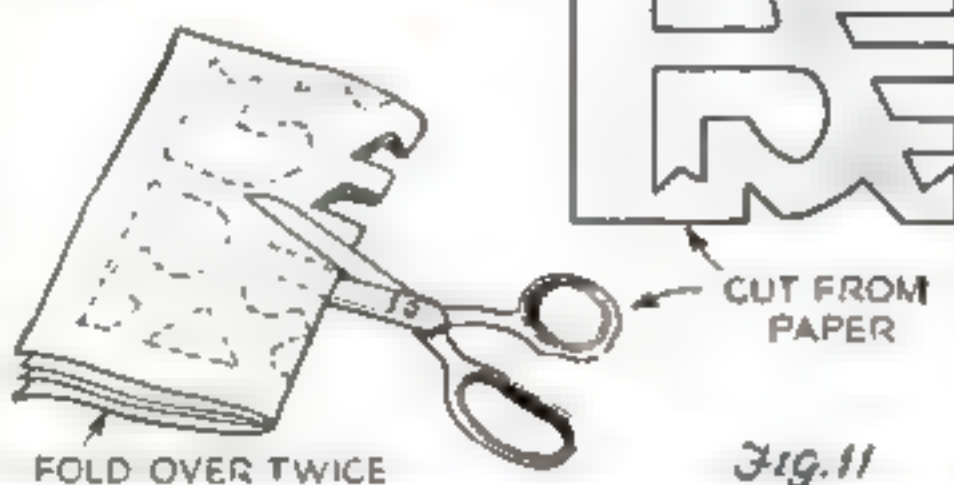
In the diagram marked Fig. 9 is shown a working fountain that requires only a cake tin, a funnel, and a length of rubber tubing put through a hole in floor.

Fireplaces are of many types. A red bulb on an extension cord let down the chimney gives a satisfactory effect of fire, and can be used between logs or among chunks of coal.

Figure 10 illustrates the construction of bookshelves. To fill them, cut strips of corrugated pasteboard 1½ in. wide and as long as the case and apply with the grooved side out. Paste paper towelling over the corrugations, pressing it down between them, first in consecutive grooves, then skipping one, two, or three to represent book backs of different thicknesses. Paint in gay reds, greens, and other colors.

Old-fashioned rag rugs are easily imitated by marking the design with crayons on coarse sandpaper. The same idea can be used for overmantel pictures. (Continued on page 105)

Suggested Design for a Window Grille
(PASTE TWO TOGETHER FOR LONG WINDOWS)



Stained-glass window and iron grille. The grille was cut from paper as in the drawing

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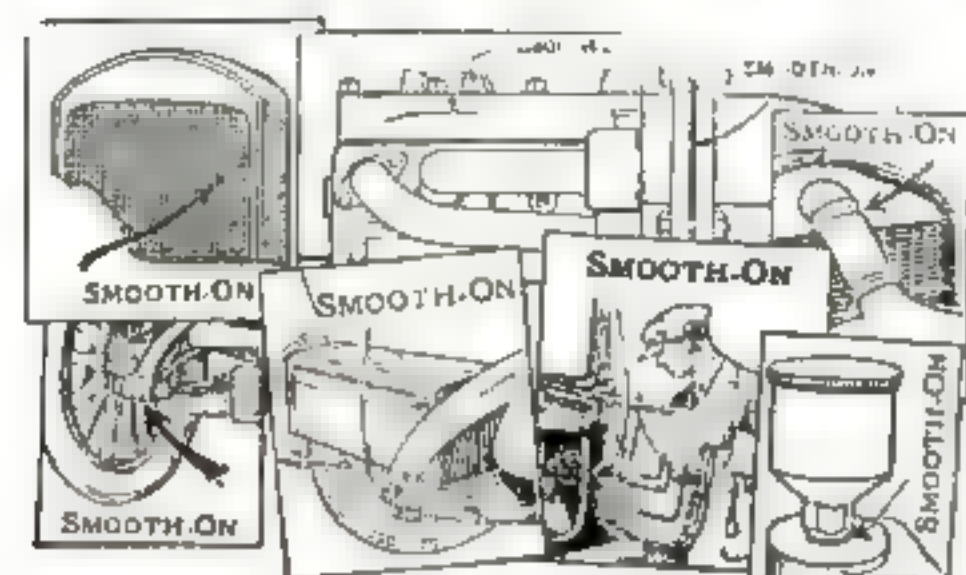
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5-36

MARIONETTE PROPERTIES

(Continued from page 101)

Grilles in church windows, ornamental ironwork for side lanterns, and the like, are cut from paper as illustrated in Fig. 11 and in the photograph of the church set.

In representing metallic surfaces, do not cover them with metal, but paint the objects brown for gold, gray for silver, blue-gray for steel, red-brown for copper. Then apply metallic paint for the high-lights only. Scumble high-lights over a dark base. For objects of this type, *papier-mâché* is best, shellacked before painting.

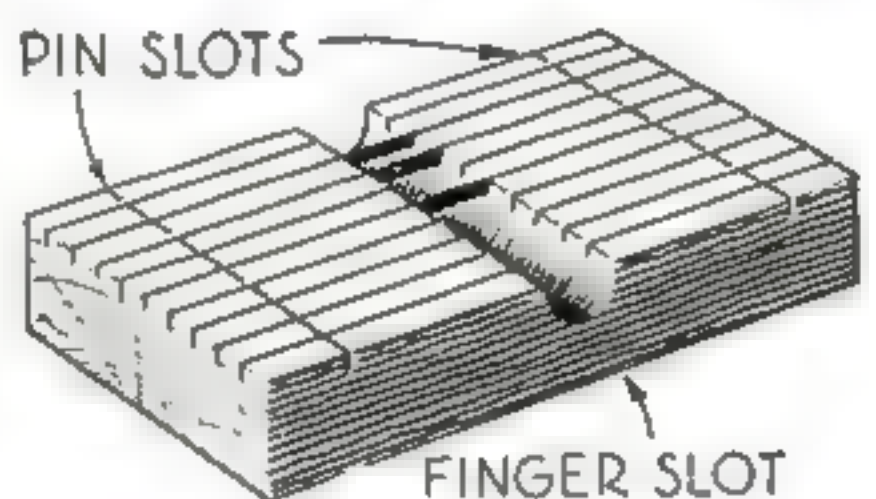
A stock outside scene may be given variety by introducing a house, which will greatly change the effect. Window boxes are charmingly effective. Glue a long cardboard box, cut in half, under the sill; then fill it with wax or soap in which to stick the wires of artificial flowers. These, like all else, must be kept to scale.

Pot-cover knobs make fine feet for bureaus, chests, and similar pieces. Large brass paper fasteners are satisfactory door knobs. Old-fashioned clothespins cut to suitable length may be used for bedstead legs as well as for other pieces. Miniature glass bottles make good lamp bases.

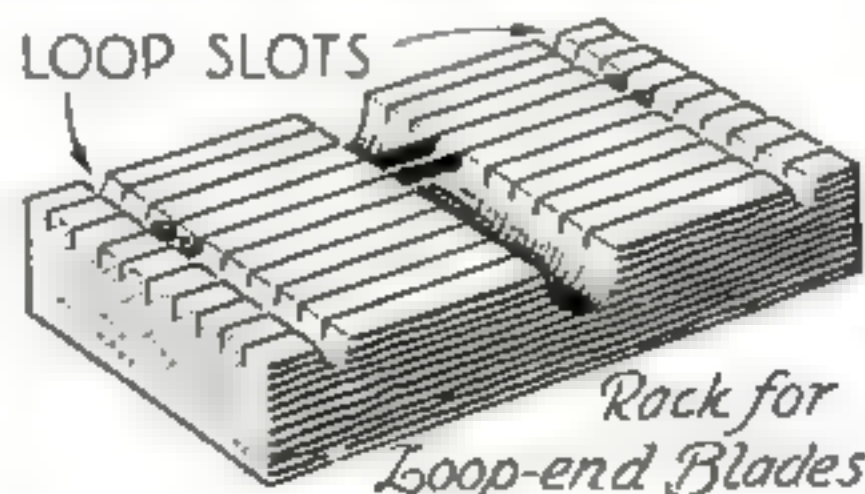
When stage furniture is made of cardboard boxes, choose cardboard that is so tough and firm it will bend readily without breaking. *Passé partout* binding is useful in this work. Always draw an exact pattern first, cut this out and lay it on cardboard, then draw around it. A piece of glass is useful on which to score the lines. Keep your knife sharp.

Commercial paste of the so-called "gluey" type is excellent, being easier and cleaner to use than glue and stronger than ordinary library paste. Many pieces can be held together with brass paper fasteners.

SLOTTED WOODEN HOLDER FOR JIG-SAW BLADES



Rack for Pin-end Blades



Rack for Loop-end Blades

THIS easily made rack will keep your jig-saw blades where they can be found when wanted. It consists of a piece of 1-in. board as long as the blades and wide enough to take the number of blades usually kept on hand.

Mark the board lengthwise with pencil lines $\frac{1}{4}$ in. apart and make a saw cut along each line about $\frac{1}{8}$ in. deep. Lay one or two blades in place, mark where the pins or loops lie, and make saw cuts or grooves to accommodate them. A larger groove, $\frac{1}{2}$ in. deep and about the same width, is cut across the middle of the board so that the blades may be easily removed with the fingers. A little oil put into the cuts now and then will insure against rust.—W. CLYDE WILHITE.



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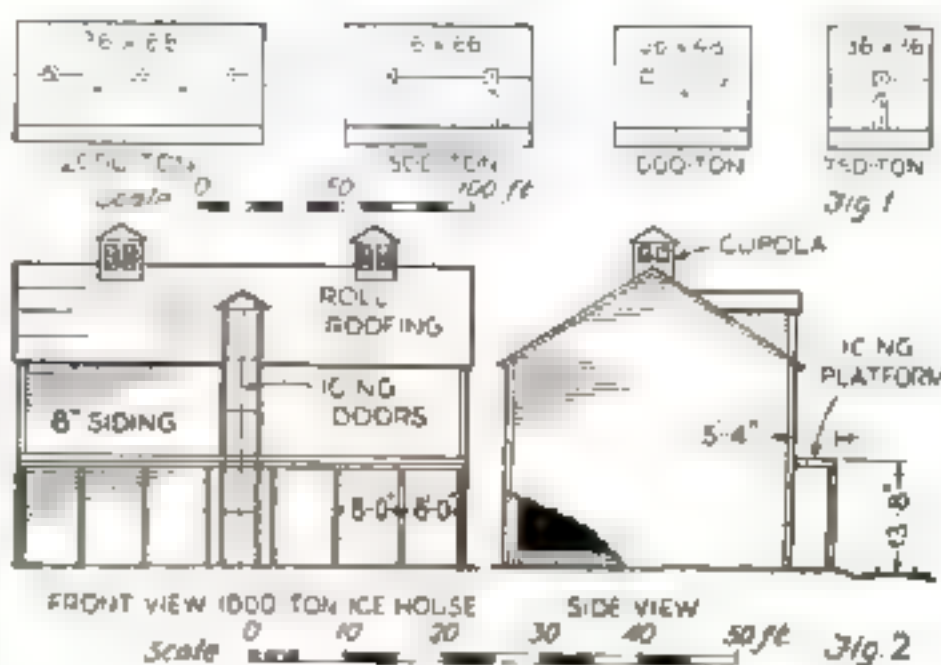
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A Paramount Picture

ICE-HOUSE MODEL BUILT FOR RAILWAY TERMINAL



Front and side elevations of a typical ice house, and top views of four different sizes

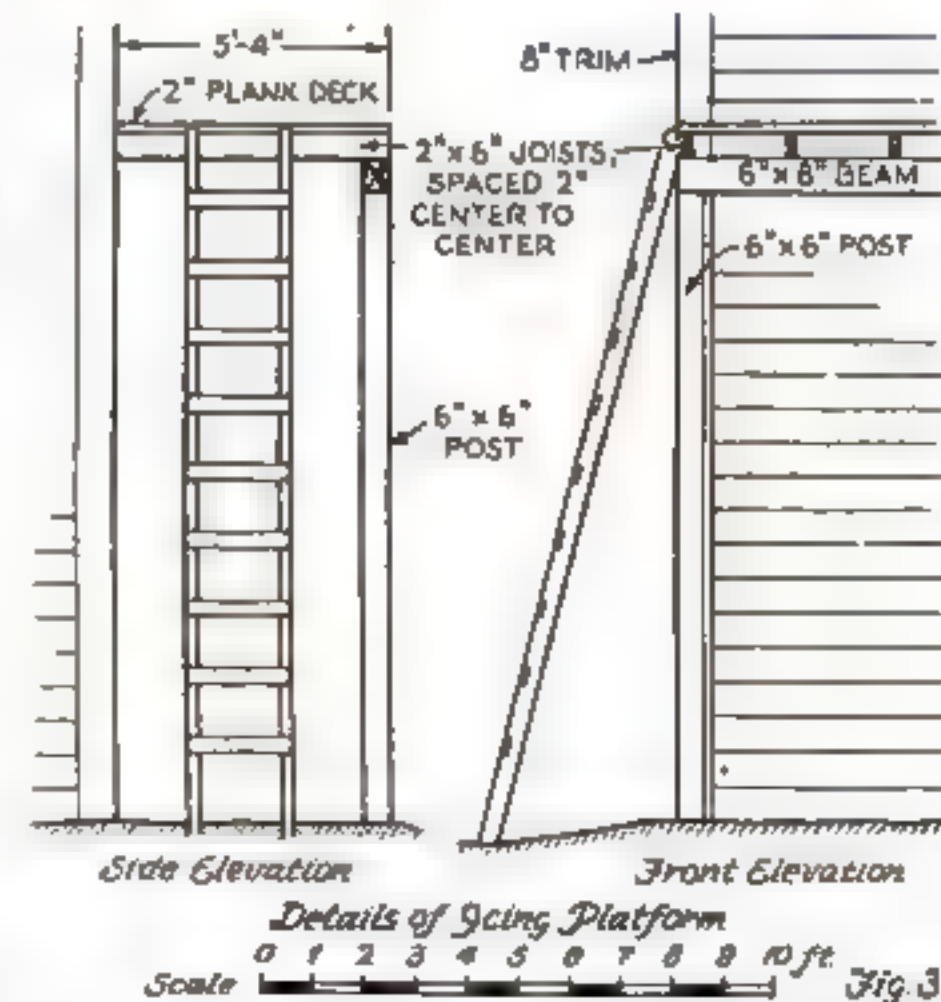
WHEN you have tired of adding bridges of all kinds to your miniature railway system and have more tunnels and depots than you can shake the proverbial stick at, why not add a well-proportioned ice house? Assuming that you now have a terminal with roundhouse, turntable, engine houses, and the like, an ice house will complete the picture. It is, in fact, a necessity if your road boasts passenger trains or refrigerator cars.

Ice houses are built in all sizes from 750 to 3,000 tons capacity, so choose the size that will best fit that vacant looking space, and get the "B & B" crew started.

Figure 1 shows the ground dimensions for the various standard sizes. Note that the width is the same in all cases, the only real difference in each being the length, number of cupolas, and number of icing doors. Unless you have an exceptional amount of room to spare, you will probably choose either the 1,500- or 2,000-ton size. Both of these ice houses have two icing doors and two or three cupolas and therefore look a little better than the smaller ones.

If you are building to a scale of $\frac{1}{4}$ in. to the foot, use a $\frac{1}{2}$ - or $\frac{3}{4}$ -in. white pine board, or plywood if you prefer, for the base, making allowance for the thickness of the side and end walls (see Fig. 2). In cutting the front panel, be sure to include the dormers for the upper icing doors. It is easier than cutting them out as separate pieces and will make the model much stronger. Before fastening the front in place, cut small openings at regular intervals to accommodate the platform joists. It is better to let them extend into the building than to try and fasten them to the outer face of the wall.

When the four sides of the building and the roof have been assembled as in Fig. 2, add the cupolas. These are shown in detail in Fig. 4. An opening may be cut in the roof to receive them, or they may be made so that they will straddle the ridge. The latter method was found to be the more satisfactory, each cupola being made (Continued on page 107)



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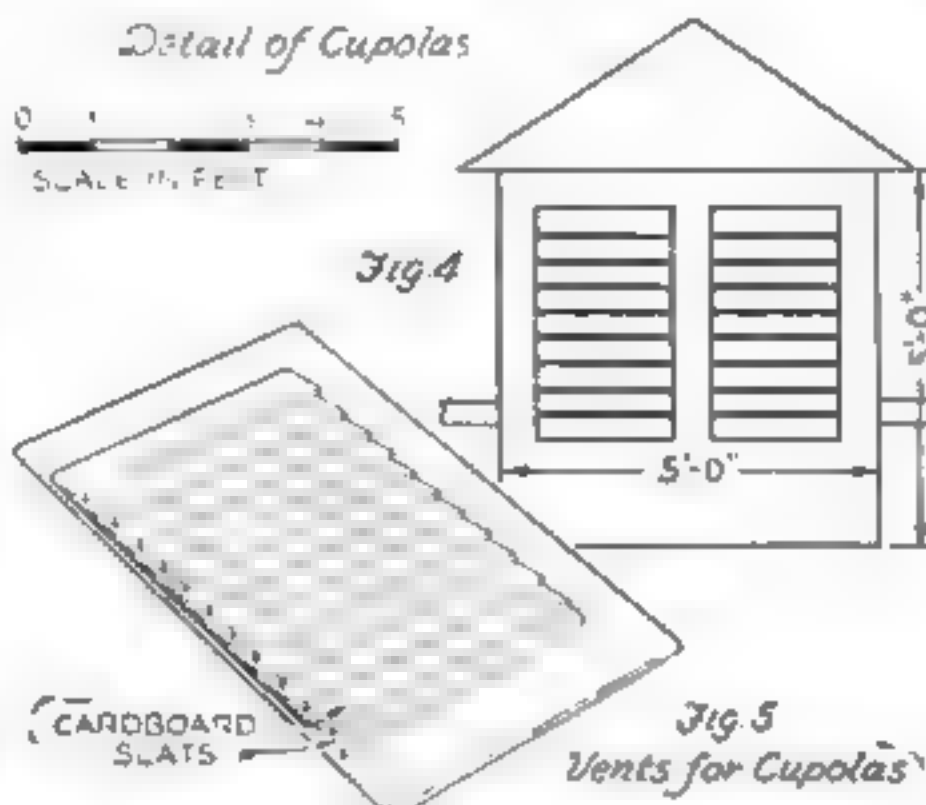


ICE-HOUSE MODEL BUILT FOR RAILWAY TERMINAL

(Continued from page 106)

from one continuous strip of cardboard, folded to form the four sides.

The vents may be drawn in with ink on the sides if you wish, but the following method, although somewhat tedious, will more than make up for the extra amount of work: Mark and cut out the openings for the vents, then fold the cardboard and make sure that it will fit the roof, but do not fasten it in place. Using the same thin cardboard, cut a number of strips $\frac{1}{8}$ in. wide and 5 or 6 in. long. Glue these strips together, lapping one over the other as shown in Fig. 5. After the glue has set, cut the laid-up strips into sections just



large enough to fit behind the openings cut in the sides of the cupolas. Glue them in place and then attach the cupola to the roof.

Do not use cardboard or any substitute for the icing platform. As the deck will be left unfinished, it will have to be made of wood. Although the drawing is made in detail, you may wish to simplify it to some extent. If, however, you wish to carry it out as shown, try to obtain a Japanese calendar made up of narrow strips of wood about $\frac{3}{16}$ in. wide and less than $\frac{1}{32}$ in. thick. These strips can be used for the planking and will save a great deal of work. Incidentally, they may be used also for window and door trim, ridge boards, and siding for all frame buildings or in any place where a 1 by 8-in. board might be used in the full-size structure.

Your ice house should be finished in the same color scheme as the rest of your shop buildings, but leave the deck of the platform unfinished. Full-size dimensions have been shown on the drawings so that it will be relatively easy for you to choose a scale to fit your particular system.—J. W. CLEMENT.

SHORT, practical articles on model railway construction are always welcomed, and payment is made for those which are found available for publication.

COMPOSITION BOTTLE CAPS SERVE AS DRAWER KNOBS

RECENTLY I came across a number of old antiseptic bottles. Before throwing them away, I removed the heavy, modernistic composition caps and set them aside, just as many shop owners do with odds and ends, because you can't tell when such things might come in handy. When I repainted and rearranged my shop recently, I built a set of small drawers, using only the material I had on hand at the time. Coming across these caps, I immediately saw that they would make really beautiful and durable drawer knobs. A small hole was drilled through the center of each, and the cap was attached to the drawer with a nickel-plated roundhead screw. These knobs are the equal of any that can be bought and give a modern appearance.—BURL KNUTSON.

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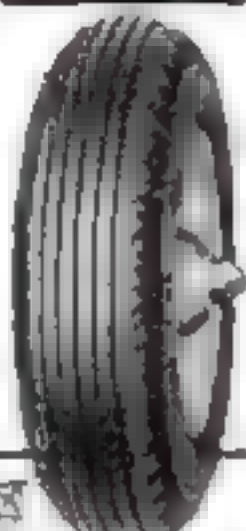
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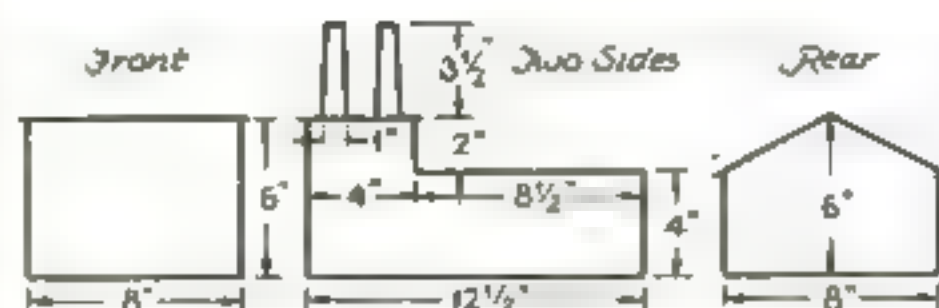
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A black and white photograph of a man in a military uniform standing in front of a large, ornate building, likely a government or military installation. The man is in the foreground, slightly to the right, looking towards the camera. The building behind him has a prominent central tower and multiple wings. The scene is outdoors, and the image has a grainy, historical quality.

The windows and door of the model are drawn with pencil and are not painted. The side walls and ends are painted green; the roof, a bright red. The entire model is then varnished. The chimneys are made from a broom handle cut to correct length, tapered slightly, and painted black.—V. W. PHILLIPS.



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ADDING A MINE TRAIN TO MODEL RAILROAD

(Continued from page 108)

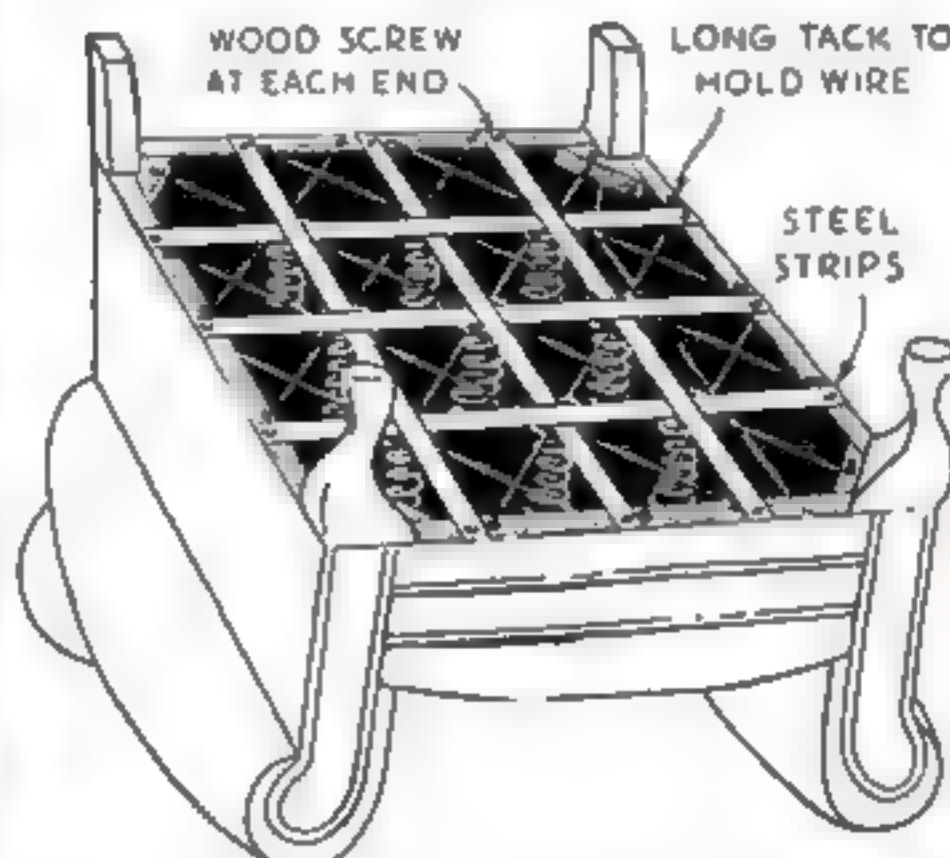


Drawn by a remodeled locomotive, the mine train runs back and forth on the high trestle

nears the end of the trestle, the trip catches the reverse and sends the train backing into the mine, where the process is reversed. This operation keeps up indefinitely, the speed of the train being adjusted to a point where it strikes the trips with just enough force to throw the reverse lever but not enough to cause derailment

A low, flat body should be fitted to the locomotive, as shown, with one or more gondolas, not more than half as long as the "loco," to carry the coal. Anything from a simple chute to carry coal to the sidings below to an elaborate breaker shed may be built at the end of the trestle.—PAUL R. WARFIELD.

FLEXIBLE STEEL STRIPS REPLACE OLD WEBBING



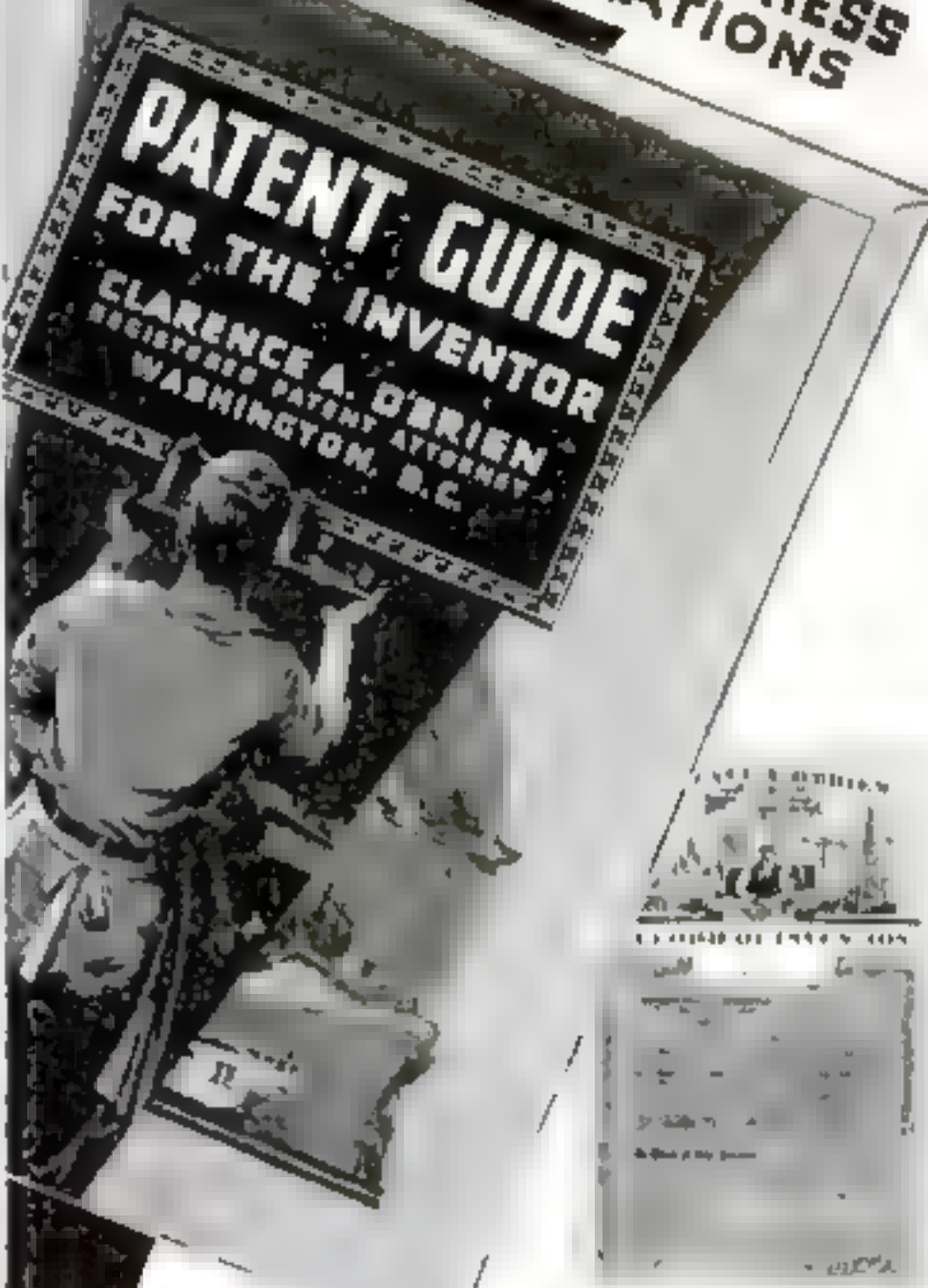
The old webbing is replaced with strips of the steel ribbon used to band packing cases

SPRING-UPHOLSTERED furniture often can be permanently repaired by replacing the old webbing with flexible, ribbon steel like that used in banding packing cases. In applying it, proceed exactly as if using the webbing. Fasten the steel strips in interlaced fashion, using a wood screw at each end. The springs should be held out of the way while the steel strips are being fastened so that they will not sag more than desired. After strips are affixed both ways, arrange the springs in their proper places and tie them in position with heavy twine or strong, flexible wire. The writer found that ordinary stranded radio antenna wire suited the purpose excellently. When the job is finished, tack black muslin over the bottom of the furniture.

The steel strips are extremely flexible, yet far stronger than the usual webbing. They may be bought in one continuous strip from hardware dealers or in many cases obtained without cost from the shipping department of some business concern. Usually they come with holes punched about 4 in. apart and may be cut so a hole is in the proper place, at least at one end of each strip. Holes may be reamed larger with the end of a file.—W. G. LOWNDS.

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YOUR MICROSCOPE SHOWS NATURE'S FACTORIES

(Continued from page 45)

gradually over a flame, until too hot to touch, if you want to confine the bacteria supply only to those specimens present in the buttermilk. After the glass has cooled, spread a thin film of the buttermilk in the center of each slide. Set aside to dry, or hold the slides over a low flame until all moisture has evaporated.

It is now necessary to fix the bacteria present. This kills them and at the same time preserves their forms. Simply letting them soak for a few minutes in ninety-five-percent alcohol is one way. A quicker method is to let one or two drops of alcohol fall on the slide where the film has been formed, tilt the glass until the alcohol spreads in a thin layer, lay the slide on a nonflammable surface, and then touch a lighted match to it. The burning alcohol effectively fixes all bacteria present.

THE next step is staining. There are numerous bacteria-staining preparations available, some of them intended for selecting certain organisms to the exclusion of others, while some are designed to bring out certain characteristics of individual bacteria. For your purpose, Loeffler's methylene blue solution, which has been described in a previous article of this series, is excellent (P.S.M. April '36, p. 44). Methyl violet or mercurochrome can also be used. Lay the slide on the table, and let one or two drops of the stain fall on the area containing the fixed bacteria. After the methylene blue has acted for a minute or so, wash it off with clear water and dry the slide. Usually this overstains, so that the slide must be placed in alcohol, or a few drops of alcohol dropped on the stained area, in order to remove some of the methylene blue. The alcohol usually affects the stain in the bacteria less than in other substances on the slide.

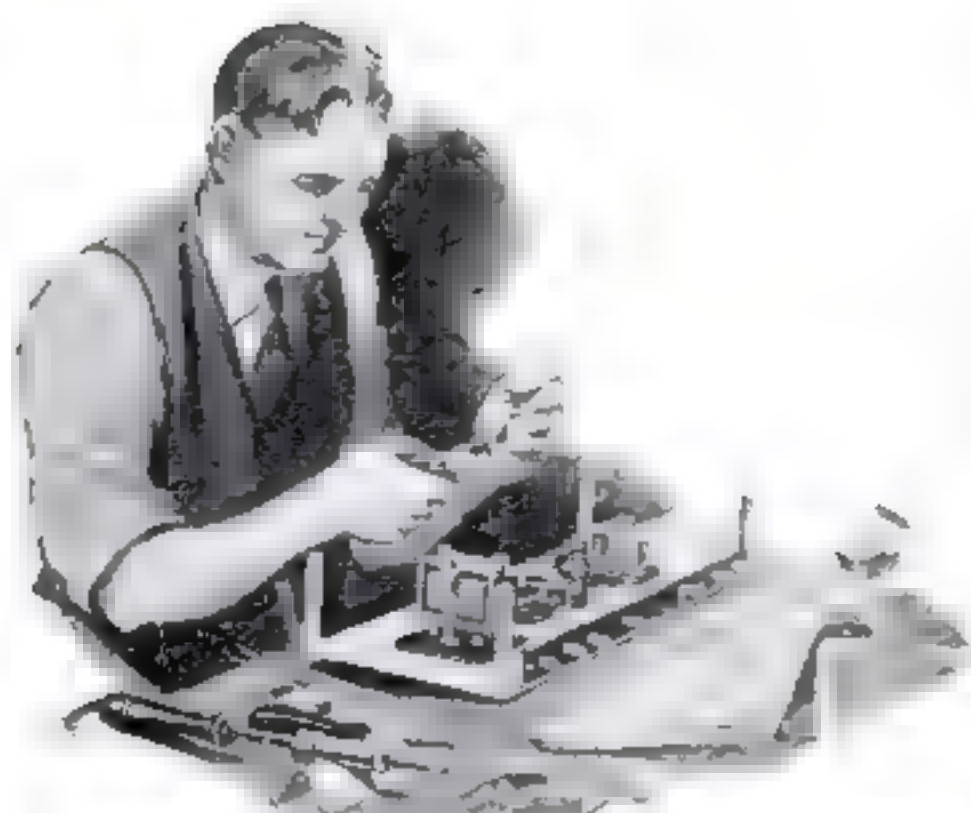
Finally, after the alcohol has evaporated, place a drop of Canada balsam on the slide and over it lay a perfectly clean cover glass. Because you may want to inspect the slide through an oil-immersion objective some day, it is best to use a very thin cover glass such as a No. 1, so that the lens can be placed close enough to the stained bacteria to get them in focus.

In a similar way you can prepare slides of bacteria from various other sources, such as stagnant water, milk, and hay infusions. When treating milk or cream, it may be necessary to remove the fat globules present. This can be done by immersing the slide for a time, after the film has been fixed, in xylol.

Certain bacteria are highly dangerous—far more menacing, perhaps, than a roomful of dynamite. Unless you are an experienced bacteriologist, do not attempt under any condition to make slides of pus from wounds, sputum of diseased persons, material obtained from spoiled cans or jars of food, or organisms from any other source that might include bacteria of disease or infection.

YEASt plants are easy to prepare for observation. Get a cake of yeast from the grocer, soak it in a little water to make a thin paste, and smear some of this paste on a slide. Add a drop of water, followed by a clean cover glass. Your microscope will reveal yeast as being a single-celled plant of extreme simplicity. Many of the cells, however, will be linked together, or will contain buds of various sizes. Such plants are reproducing. When a yeast plant grows, it sprouts a bud that becomes another yeast plant, and eventually breaks away to face life on its own. Sometimes, several new yeast plants cling together in a chain for a while before breaking up into individuals.

You can stain yeast plants by adding dyes to the water in (Continued on page 111)



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(Continued from page 110)

which they are present. An easy way of doing this is to place a drop of stain at one edge of the cover glass and hold a blotter to the opposite edge. The stain will move across the slide, under the cover glass. In a similar way, you can flush the preparation with clear water after staining. Try methylene blue, methyl violet, eosin, and mercurochrome. You can cultivate yeast plants by placing bits of yeast cake or tablets in a solution of molasses and setting it in a warm place for a few days.

MOLDS, you will find, are more complex in structure than yeasts or bacteria, but are easier to study at low powers of magnification. One of the most common molds is *Rhizopus nigricans*, commonly known as bread mold. To obtain a plentiful supply, rub one side of a slice of bread across the floor, and then lay it, with the side that was in contact with the floor uppermost, in a saucer containing a little water. Set this in a dark place under a bell jar or other cover that will confine moisture. In a few days you ought to have a luxurious growth of mold.

Close examination of bread mold with the naked eye reveals that there is a layer of white, glistening material that looks like a blanket of fine wool or cobweb material. This is the mycelium. Rising from this layer of mycelium are tall stalks bearing tiny black balls. These balls are the sporangia, or spore-producing bodies. The spores, which do the same work as seeds in higher plants, are distributed over the earth by the winds. Bread mold also reproduces sexually, but more rarely than by the spore method. Between two hyphae or stalks there will develop short, bulbous branches whose ends come together and unite. There appears at this junction a thick-walled, dark-colored resting spore. Such spores have the power of producing a new mycelium whenever favorable growing conditions are found.

Under the microscope, bread mold becomes a beautiful and interesting object. Note that the hyphae or spore-bearing stalks are not divided into numerous cells as are the stems of higher plants like the clover. Try to find a spore chamber that has been broken open to release the myriads of tiny, black, football-like spores. Look also for resting spores (zygospores) between two conjugating filaments.

You can obtain other specimens from moldy foods of various kinds, such as spoiled oranges, decaying pears, or moldy cheese. Frequently profuse growths of molds, such as *Penicillium* and *Aspergillus*, can be produced by moistening pieces of bread with grape juice or cane-sugar water, and letting them remain for a few days under a bell jar as described. Do not inhale mold spores.

IN MAKING slides of bacteria, yeasts, and similar material which you want to distribute in a thin layer, you will find a little trick employed in research laboratories of great help. This consists of cleaning two cover glasses, placing a drop of the specimen material, which always is in the form of a paste or liquid, on one glass, and bringing the other in contact with it. Let the cover glasses come together, but do not press them; then separate them at once by a sliding movement. This spreads the specimen material in a thin, even layer over each glass. After a little practice, you will be able to perform the operation easily. Tweezers for grasping the delicate cover glasses probably will help.

A common way of fixing bacteria when distributed over cover glasses in this manner is to pass the glass rapidly, several times, through the tip of an alcohol or gas flame. This takes the place of the flaming-alcohol method already described.

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SERIES II

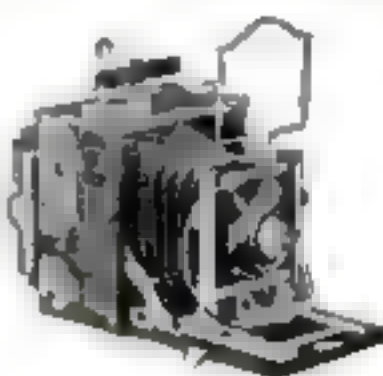
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Two prize winning letters in POPULAR SCIENCE MONTHLY'S new Secrets of Success contest—"What Home Study Has Meant to Me"—are printed below. Read these stories carefully because your own career may be just as interesting and inspiring to other readers. If you think so, put it down on paper and send it in. We will pay \$5 for every letter we publish.

CONTEST RULES

Only letters from bona fide home study school students will be considered and these must contain the name of the school and the name of the company, or companies, for whom you have worked since graduation. (Names, however, will be deleted from the letters when published.) We also want to know the kind of course you took and the type of position you have held. Your own identity will be kept anonymous, if desired.

We are interested in facts, not literary ability, but please write clearly, completely, and keep your letter within 750 words. We are not looking for "get-rich-quick" stories or freak adventures, and authors must be prepared to substantiate the truth of the statements. Manuscripts submitted and printed become the property of this magazine, and we are not responsible for the return of rejected stories unless sufficient postage is provided for this purpose. Address your contribution to Success Story Department, POPULAR SCIENCE MONTHLY, 353 Fourth Avenue, New York, N. Y.

HOME STUDY AN ESSENTIAL INSTITUTION

Home study—as evidenced daily in almost countless cases, has developed from an experimental to an established and essential institution in the lives of Americans who are making good and who owe their success to it.

I would hate to speculate even in my spare moments where I would be, what my position and earnings would be by now if I had not, through some sort of fate, had the determination to go ahead or been inspired to sign up for a course in accounting in 1918 which led to a bookkeeping position in 1919. Practically all of this course was completed in France.

Realizing that this was only a foundation and that executives demand facts or the ability to secure them through past training, I almost immediately signed up for a two-year course in advanced accounting to equip myself for a larger position. Because of this course (and before completing it) I was able to join a firm of certified public accountants. This enabled me to get broader experience in auditing records of industrial, publishing, charitable, movie and other organizations.

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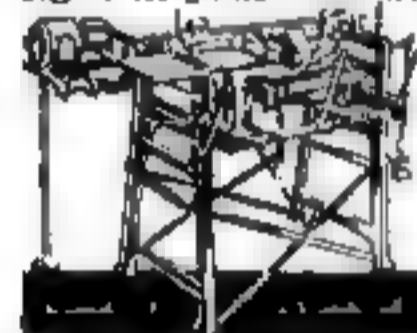
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Secrets of Success

As the result I enrolled with the School, Chicago, in 1914, taking a course in architecture. I studied three or four nights a week for two years, covering the field of engineering, mathematics and building construction. It was hard work but the text books were wonderful.

My intention was to try for a job in an architect's office but my shop foreman, who was interested in my work and studies, suggested that I ask for a transfer to the research laboratories of our own company even if I had to work for next to nothing. The transfer was arranged and as my foreman had predicted, the pay was less than I had earned in the factory. I had no regrets, however, for money meant little; the opportunity, everything.

Finding that the knowledge I would need for advancement would be more in the line of chemicals and ceramics, I wrote to the School for advice. These people gladly arranged a special new program for me in chemistry, physics and a general college preparatory course which I followed for two years more . . . a total of four years with the School.

I continued in the research laboratory for eight years, through one position after another until I was on a par with most of the college trained men with whom I was associated, and for these advancements I thank the home study with which I kept up right along.

During the mild depression of 1921 I was transferred to the factory on special work and found it decidedly distasteful. I had been married about a year at the time and my wife, seeing an advertisement in one of the trade magazines that looked promising, persuaded me to answer it. The upshot was that after several interviews, I left the Company and became superintendent of the Company, Waltham, Mass.

Once more I turned to home study, for in my new job I felt the need of executive training. This time it was with the University and with the help of this school I have rounded out my technical education with a business course.

Today I am still at the same place. My salary reached a comfortable figure in 1929, suffered some reduction through a voluntary cut on my part during the depression but it is now on its way back. Progress has been with the aid of men for whom I have worked and who have continued to be my friends, but the preparation which has enabled me to step up when opportunities came has all been through home study.

I now have two children in the upper grades of school. I have a good home. I am a member of the Rotary Club and active in civic affairs. It is interesting to note, too, that most people think I am a college graduate although I frankly explain when they put the question direct. At forty-two I am preparing to enter a wider field of work in my profession. The decision is not yet made but lack of knowledge will not prevent me any more than it did twenty-three years ago. The habit of study has stayed with me. Opportunities, I must make for myself.

—C.H.L., Waltham, Mass.

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Name Stamps Made *with* Glue

WHEN you need rubber stamps for printing your name and do not wish to go to the expense of having them made commercially, you can prepare your own in a plaster mold by using glue instead of rubber. They will be quite durable; in fact, after they have been set aside for two days to cure, they are almost as resistant to water and heat as real rubber. The cost is negligible.

Get a friendly neighborhood printer to set up the desired wording in well-leaded type of the size desired. Tie the type tightly with string, and around it fasten a form of cardboard strips as shown.

After oiling the type, fill the form with plaster. Use a good grade of plaster mixed to normal consistency with water, and add a dash of salt to make it set more quickly. Brush the type as the plaster is being poured to make sure that all of the depressions are being filled. When it has set, remove the cardboard form,



The glue is melted after being mixed with glycerine, water, and potassium bichromate



The plaster mold is fenced with paper tape so the hot glue can be poured over it

make a new fence around the mold with paper tape or cardboard, and oil the face of the plaster mold. The mold then can be used for making any number of stamps.

A good grade of ordinary granulated glue should be used. Place a sufficient quantity in a small receptacle and wet it with a solution of 1 oz. glycerine mixed with 1 oz. of water in which 10 grains of potassium bichromate have been dissolved. Use only enough of the solution to make the glue swell to its limit. You can then gently heat the mixture over a candle, stirring thoroughly, until it melts and forms a very thick syrup. Pour it into the mold and allow it to set for some time before attempting to remove it. It is an advantage to

The type with its cardboard fence ready to receive the plaster, and, right, removing the glue from the plaster mold

allow the compound to remain in the mold for a day. Then allow it to cure in daylight; this will cause the glue to become tough and insoluble. It may then be trimmed and glued to a suitable handle.

This formula was found best for the purpose, but experimenters, if they wish, may also add to the glycerine and water solution a like quantity of thick molasses; or to the melted compound, before casting, an equal amount of linseed

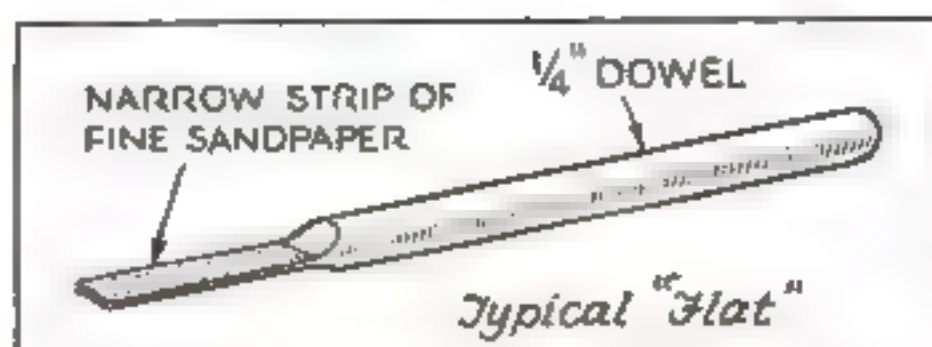


oil. By making either of these changes, the consistency of the stamp can be altered to adapt it better to any special or unusual requirements.—K. M.

SANDING STICKS AID THE MODEL MAKER

SANDING sticks are easy to make and are as useful to the model maker in the final shaping of small, intricate pieces as tiny Swiss files are valuable in fine die work.

To make a set of these sticks, cut half a dozen 6-in. lengths of $\frac{1}{8}$ - and $\frac{1}{4}$ -in. wooden dowels and fashion the ends into shapes similar to small Swiss files, such as squares, flats, tapers, half-rounds, and ovals. Cut a sheet of sandpaper (No. 00



One of many types of sandings sticks which may be made for finishing parts of models

or finer) into narrow strips and fasten them to the shaped ends of the dowels with stick cement (used extensively for cementing garnet paper disks to sanding wheels). When worn, the paper can be readily peeled off and replaced.

In special cases where the sanding surface is to be spoon-shaped, it will be necessary to dip the end of the stick into glue and roll it in abrasive grains of the proper fineness.—W. J. K.

AMAZING TESTS SHOW SECRETS OF THOUGHT

(Continued from page 13)

of electrical impulses than simply reading it. So far, the tests show that the more intelligent you are, the less body current you generate during thinking. Also, they show that when you are chilly, the voltage is greater than when you are comfortably warm.

At points of special interest during the test, Dr. Max opens the shutter of his recording camera and the shadows of the pulsating quartz filaments leave their permanent zigzag record on the sensitive film. By studying hundreds of such records, the scientist hopes to find the solution to another physiological riddle: How deep is a deep sleep? From his researches, he expects to discover some electrical yardstick by means of which he can measure the degrees of slumber.

THERE are probably less than half a dozen similar laboratories in the country. At the Loomis Laboratories, Tuxedo Park, N. Y., you see the most elaborate scientific equipment of all for the study of these mysterious currents. There, instead of a recording camera and vibrating quartz filaments you find a great horizontal drum, eight feet long and forty-four inches in circumference, capable of holding a continuous, eight-hour record.

In the room where the subject sleeps, a sensitive microphone picks up each sound and a photo-electric, or light-sensitive, cell records every movement on the bed. Amplified current, coming from the electrodes held in place against the sleeper's scalp, actuates twin high-speed, siphon recorders, hollow pens with a continuous flow of ink, which trace their wavy lines a fifth of an inch apart on paper attached to the revolving drum.

One line is in red ink, the other in green. The red line shows each heartbeat, each respiration, each movement of the subject on the bed, while the green line records the fluctuation of electric current from the brain. The two pens advance along the drum at the rate of one foot an hour. Three ratchet devices sum up the heartbeats, the respirations, and the bed movements every time the drum completes a revolution, marking the rate per minute on the paper. As the drum is driven by a constant-speed motor and acts as its own clock, electric contacts enable the scientists to send a given stimulus to a sleeper at regular intervals and to note the effect on the currents from the brain.

The finished graph produced by this method is a sheet forty-four inches wide and eight feet long. To simplify studying the huge record-sheet, Dr. Loomis and his associates view it first through a red glass, so that only the green lines are visible, and then through a green glass, so only the red lines show.

FROM such study of these scientific hieroglyphics, Dr. Loomis believes he has discovered six types of brain waves, each recognizable through the spiked or balled character of the sharply zigzagging lines. During certain hours of the night, he reports, there are mysterious bursts of electrical activity in the brain. These bursts appear in trains and last from five to twelve seconds.

One curious thing observed at Tuxedo Park is that steady snoring has no effect upon the electric current flowing from the brain, but an isolated snore, apparently startling the sleeper, starts a train of increased pulsations. Many sounds, such as the distant slamming of a door, will cause increased electrical activity in the brain cells when a person is asleep but will not do so when he is awake.

Little by little, laboratory explorers are feeling their way into this new realm of science. The researches carried on thus far, fascinating as they have proved, merely scratch the surface of the possibilities ahead.

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ROUNDING ENDS OF FURNITURE LEGS

FOR the amateur woodworker who desires to make his furniture completely by hand in the early American style, or for those who do not have a lathe, the device shown can easily be made for rounding the ends of legs or any similar pieces.

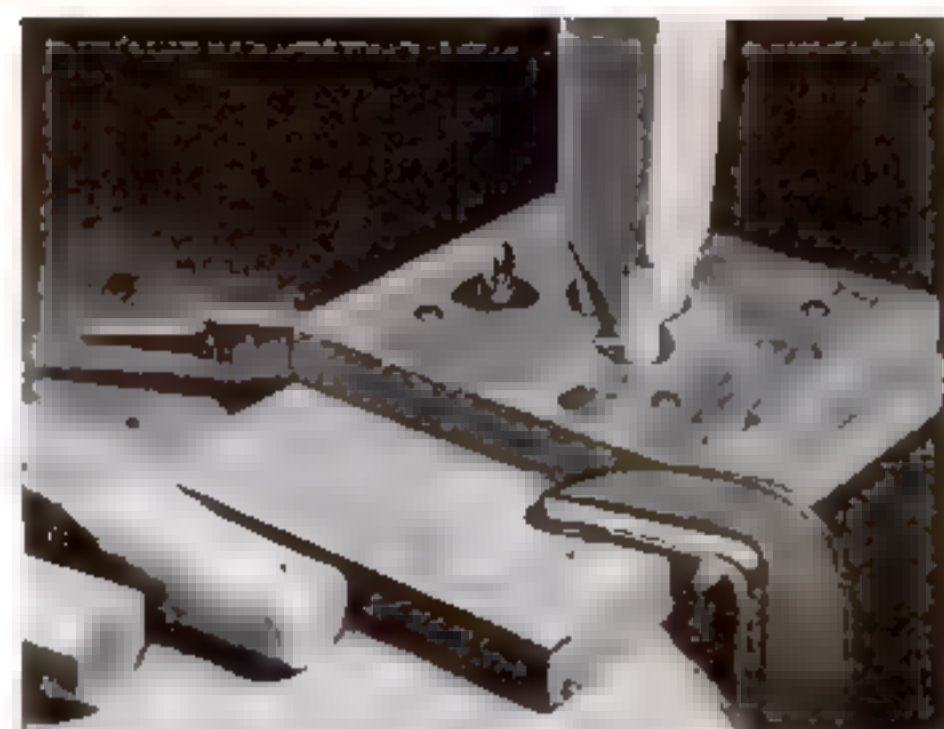
Two pieces of wood about 8 in. square are screwed together with the grain crossed. These are then bored to the same size as the holes into which the legs are to be fitted in the furniture.

The hole must now be cut to a conical shape for about three quarters of the depth, the upper end being a third larger than the original size. A clearance hole is also bored, as shown, for the chips.

A chisel, or an old file ground down, is used for a cutter. It is imbedded between the pieces of wood so that the cutter edge is in line with the conical hole, and is secured either by a wedge or a bolt.

The end of the leg to be shaped is first roughly trimmed to within 1/4 in. of the desired size and then inserted in the large end of the hole and rotated against the edge of the cutter. As the cutter bites into the wood and takes off a shaving very much as if it were a plane, the wood is pressed steadily into the hole until the end is smoothly rounded.

—LAWRENCE G. BETZ.



After being roughly shaped, the leg is inserted in the tool and rotated



The two halves of the tool separated to show the construction. In this case an old file was used to make the chisel-like cutter

LARGE DISPLAY TYPE SAWED FROM WOOD



If only a few letters and figures are needed, they may be cut from rosewood on a scroll saw

AMATEUR printers often wish for an inexpensive way to provide a variety of large display type for their home printing presses. If a scroll saw is available, the desired letters and figures can be successfully cut from wood for 72-point and larger sizes. The method is also



After being cut out and buffed, each letter is blocked up type high

suitable for making ornaments and color blocks.

First trace the characters in reverse on thin pieces of rosewood, which have been well sanded. They should be cut slowly with the scroll saw operating at high speed, in order to give the cut edges a polished finish. Use a fine jig-saw puzzle blade. Coat each letter with thin shellac to seal the pores; then mount it with waterproof casein glue on a hardwood block so that it will be type high. The letters may be lightly buffed, if desired, to improve the surface finish.—E. V. B.

BASE OUTLETS PAINTED WHITE FOR VISIBILITY

TO PREVENT having to fumble around when plugging a lamp or electric appliance into a wall or base receptacle behind a davenport or chair or in a dark corner of the home workshop, paint the receptacle itself white as illustrated. This idea will save precious seconds in the morning in getting the toaster started if the outlet is in a dimly lighted place.

The wall plate may, of course, be removed when painting the receptacle. The inside of the slots are not painted, so the slots will stand out clearly.—JOSEPH J. LUKOWITZ.





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UNCLE SAM WAGES WAR ON MARIJUANA

(Continued from page 15)

most common effects of smoking marijuana?

Cannabin, which is the active narcotic principle, affects the higher nerve centers almost exclusively. A person smoking several marijuana cigarettes will first experience a feeling of exaltation and well-being. A happy, jovial mood is induced and everything takes on a humorous aspect. Tell a person at this stage that his mother has just died and he will laugh loudly at the news.

With this increased happiness, there comes a feeling of greater physical and mental strength. Nothing seems impossible. Musicians and cabaret entertainers are said to furnish one of the largest classes of users for this reason—it stimulates their imagination and temporarily increases their ability. Visions appear, sometimes of a pleasant nature, but more often gruesome.

THE smoker's sense of space and time becomes distorted. The room in which he is located may appear minute, and everything in it is an infinitesimal spot upon which he gazes curiously like some giant in a doll house. Time becomes interminable. A second seems like a minute, a minute like an hour, and an hour assumes the aspect of a whole day. The time consumed in walking from one chair to another may seem like days on end.

Noises sometimes are magnified. A match dropping to the floor will sound like a gigantic thunderclap reverberating through the universe, rolling on and on until it fades away and is succeeded by deathlike silence. The flame of a match or the glow from a lamp will fascinate the smoker.

This delirious state will merge, if the dose is large enough, into a feeling of general weakness accompanied by fatigue and a desire to sleep.

If the effects of marijuana were confined to such sensations, it would affect the average person only as a moral problem. Unfortunately, it has a still worse side.

Continued use of the drug, for example, will lead to a delirious rage in which the addicts are temporarily irresponsible and inclined to commit the most horrible and violent crimes. Any increase in crime in a community usually is attributed by authorities to marijuana. Many murders are committed either by persons not responsible while under the influence of the drug, or by persons who deliberately smoke it to gain a false courage for the commission of a planned slaying. Prolonged use is said to lead to mental deterioration and eventual insanity.

THE dangers to which addicts are exposed and to which they expose others are shown in some of the terms associated with Indian hemp. In Malay, where it is eaten as hashish, the murderous frenzy in which the native dashes with a weapon into a crowd screaming: "Amok! Amok!" (Kill! kill!) is due to the drug, according to some travelers. Our common expression "to run amuck" is derived from this source.

The origin of the word "assassin" has two explanations, but either demonstrates the menace of Indian hemp. According to one version, members of a band of Persian terrorists committed their worst atrocities while under the influence of hashish. In the other version, Saracens who opposed the Crusaders were said to employ the services of hashish addicts to secure secret murders of the leaders of the Crusades. In both versions, the murderers were known as "haschischin," "hashshash" or "hashishi" and from those terms comes the modern and ominous "assassin."

It has been said that the followers of Pancho Villa, the (Continued on page 120)



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UNCLE SAM WAGES WAR ON MARIJUANA

(Continued from page 119)

Mexican bandit, derived their reckless courage from smoking marijuana, and, that most of their outrages were committed under its influence.

Where Indian hemp is used as hashish or bhang, the leaves are rubbed between the hands or pieces of carpet until the resin is expressed. This is then scraped into a container and the product is treated with ether and eaten or, occasionally, cooked and the fumes inhaled. This was the "emerald green" drug of the Arabs, and the Count of Monte Cristo in Dumas' novel was addicted to hashish eating.

AUTHORITIES, Federal and local, are employing the only possible weapon against the drug—that is, destruction of any plants suspected of being used for narcotic purposes. It is particularly abundant as a wild plant in western Missouri, Iowa, Southern Minnesota, the Southwest, and the Western States. The "slough district" of the Illinois River valley has large stands of the wild plant, but, curiously enough, it is used very little there as a drug. Gathering the plant and seeds for legal purposes is a local industry in this district. In addition to rope fiber, the plant yields a commercial oil used by artists; the seeds are constituents of most manufactured bird foods, and dust from the dried seed pods is sold to pharmaceutical companies.

Kentucky furnishes most of the legal crop for medicinal purposes. Little is grown now for the fiber, the last survey showing only 2,400 acres under cultivation; of that number, 1,700 were in Wisconsin and 300 more were reported in Illinois.

As a result of Federal drives, states are gradually adopting and enforcing laws against marijuana; but even so, the apathy of the

public helps to prevent the eradication of America's foremost drug. As one captain of a narcotics bureau put it:

"We cleaned it up pretty well in this city after the state passed laws against marijuana; but it is returning gradually because the public won't cooperate with us. They don't know or don't care what it does. As for the smaller towns—well, they don't even attempt to wipe it out until something horrible happens, and by that time it usually has too firm a hold on its victims to yield to attempts at suppression."

ULTRA-VIOLET RECORDING IMPROVES SOUND MOVIES

By USING rays of ultra-violet light for recording sound on motion-picture film, the indistinct and blurred recording of high-frequency waves produced by ordinary light is entirely eliminated, it was recently announced by engineers of the RCA Manufacturing Company. This means, they state, that the difficulty of recording the high-pitched voices of certain motion-picture celebrities and the tones of musical instruments that have a high frequency range has been overcome. Ordinary white light, being composed of a great many different wave lengths, makes a light medium wherein it is impossible to focus exactly all of the wave lengths at the same time. By utilizing only the narrow range of ultra-violet light, however, a sharper focusing of the lenses in the recording apparatus is made possible so that the exact and true pattern of the sounds, even in the upper or high-frequency zone of the wave band, is obtained on the film. Only simple adjustments in present sound-recording systems, it is said, are needed to adapt them to this new method.

FLYERS MEET UNEXPECTED PERILS IN QUEER AIRPLANE ACCIDENTS

(Continued from page 30)

the brunt of the ship's 100-foot drop.

Seaplanes, by the nature of their pontoon construction, sometimes carry their pilots unexpectedly to cold baths. Joseph Doran rented a seaplane for a flight down the Hudson River. He alighted in calm water at 155th Street, New York City, and, without warning, the plane overturned. Police launches, a patrol plane, and radio cars joined in the attempted rescue, as Doran drifted twenty blocks upside down, tiny river waves lapping at his helmet. At 135th Street, eager hands stopped the plane and pulled the flyer to safety.

ANOTHER seaplane, with twelve passengers aboard, while entirely safe in the air, threatened to sink whenever it landed. Flying from Nantucket to New York, the pilot noticed that the plane's left wing was low. When he landed at Vineyard Haven, Mass., he found one pontoon partly filled with water, which had entered through a small hole made at some time previously. The passengers were transferred to two smaller planes and delivered to their destination.

Skilled pilots, green students, and helpless passengers play parts in the tragedies and comedies of error and mishap. A veteran air-mail pilot took off at midnight from Newark, N. J., and nosed his speedy monoplane up through rain and sleet. In a few minutes, buffeted by heavy wind, he lost the directional radio beam. His radio raised several stations, but could not get his home port. After a long period of blind flying, through drenching rain, he came down searching for a place to land—and set his ship down on the very same runway from which he had

taken off more than four hours earlier.

Aviators flying in storms have witnessed the rare spectacle of lightning being blown sideways by high winds. Bands of light nearly a foot wide once encircled Kingsford-Smith's propeller tips as he flew through a lightning storm. The noted flyer looked out through the narrow window of the pilot's cabin to see the hubs of the propellers glowing with a ghostly bluish light which disappeared when lightning flashed, only to regain its strength a moment later. Another pilot reported that his flash light, hanging from a screw beside his knee, was lit up by current from lightning passing through it.

Planes have been known to carry as much as a half ton of ice during a winter storm. Propellers have been worn down half an inch by hail during a single flight.

PARACHUTES save many lives, but not always in the conventional manner or one which might be expected by the jumper.

James Horning of New York had the very unusual experience of leaping for a parachute jump and finally reaching the ground by climbing down a ladder. A high wind blew him two miles during a half-mile descent, into wires carrying a heavy charge of electricity. The chute caught, leaving him swinging his legs ten feet from the ground. Firemen brought ladders and he walked to safety.

Lieut. Norman Barnett was forced to bail out over Ohio when his motor cut out. He floated down in a snow so heavy he could not see the ground, and landed so hard that he broke a leg. Santa Claus, in the person of an experienced pilot and parachute jumper, dived over the (Continued on page 121)

FLYERS MEET PERILS IN QUEER PLANE ACCIDENTS

(Continued from page 120)

side of a plane, intending to distribute gifts to children, but Mrs. Santa completed the job, because the old man with the white whiskers fractured his leg when his foot doubled under him in landing.

Nor do air "accidents" always involve airplanes. At Bear Mountain, N. Y., state troopers and scores of citizens sought vainly to find a plane reported to have exploded in midair over Donderberg Mountain. Two pilots soared overhead, glasses sweeping the slopes. At last, after a day of vain searching, Government agents announced that the explosion involved a rocket signal device and parachute, sent up in a test from the naval arsenal at Iona Island.

DURING a meet at Elmira, N. Y., two brothers—Felix and Arthur Brandl—stood inside a hangar during a storm watching the wind tug at their glider, moored near-by. The gale pulled the motorless craft loose and started it rolling on tiny wheels across the field. Felix and Arthur gave chase and caught the glider. Felix soon turned loose, but Arthur hung onto the wing and was carried over the brow of a hill, only to be snatched loose by a gusty bump and blown fifty feet into some trees. The glider sailed on, crashing at last in the valley below.

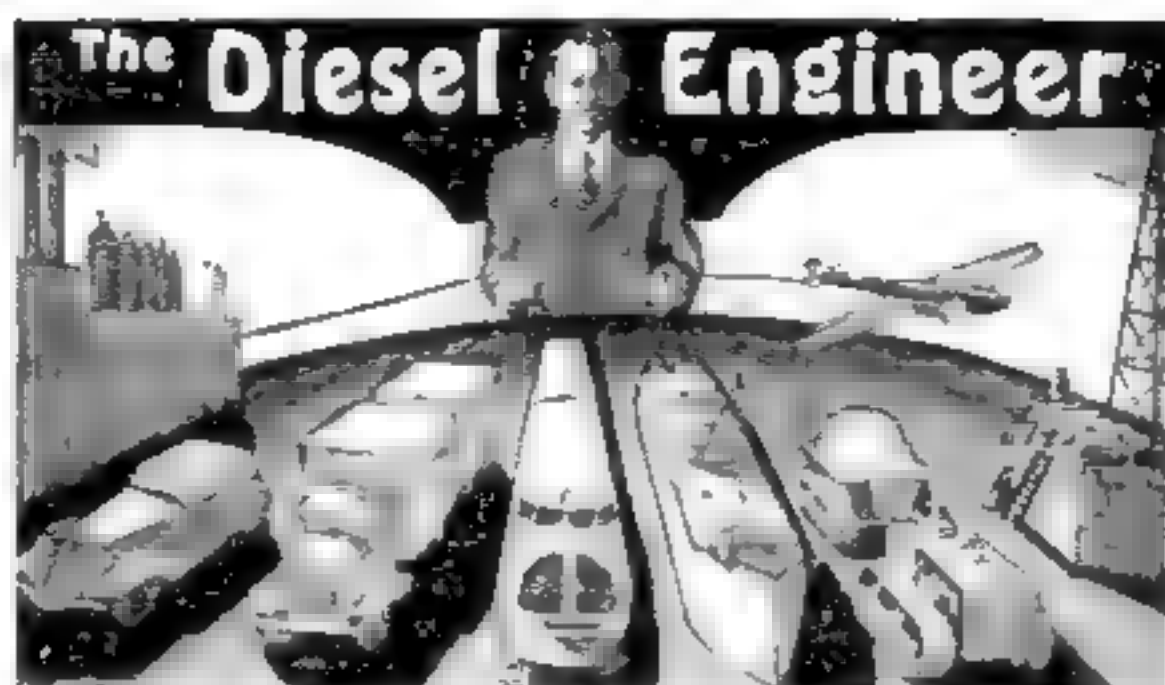
Twenty-seven years have gone by since the first fatal air crash in the United States. During that period, men who ventured aloft have experienced every kind of odd adventure.

Lieut. Thomas E. Selfridge was the first American to lose his life while flying. The manner of his death offers a strange contrast with modern planes of great swiftness. Orville Wright and Selfridge were the passengers on that historic flight. Their frail craft was catapulted into the air when a 1,400-pound weight dropped from a short derrick and, through a system of cables and pulleys, pulled it forward. The Wright biplane rose to an altitude of forty feet, stopped, and plunged into the earth. Strangely, Selfridge was killed by the impact of a cushioned seat which tore loose and struck him so hard that a guy wire was forced into his neck.

THE list of casualties is growing less, month by month. Lessons learned since that fatal day contribute to greater safety in the air. This year, private flyers will travel some 75,000,000 miles in the United States. They will fly nearly 60,000 miles for every accident bringing injury to pilot or passenger, and over 400,000 miles for each death.

For the future, even greater safety is promised. The U. S. Bureau of Commerce has ordered three types of planes in an effort to find "everyman's" craft of the air. One of these is a direct-drive autogiro, in which you can drive from your garage down the highway to a take-off field, then climb straight up twenty-five feet, finally speeding forward in ordinary flight. On this machine, the long rotors will fold back, a clutch will be provided to disconnect the propeller, and the engine will be geared to the wheels for use on the street. The pilot will have an unobstructed view, since the engine will be located back of the cockpit.

The second type is a standard small plane powered with a popular-make automobile engine; on the third, the rudder will be abandoned, control being obtained through larger ailerons which will both keep the plane in level flight and enable it to change direction. This plane will be so constructed that inexperienced pilots may land safely with the brakes set and not find their names listed among those who have undergone some strange or odd experience.



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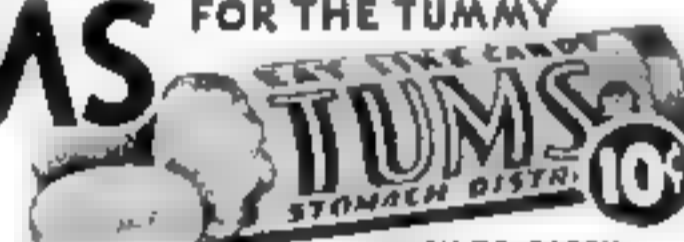


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LIONS BORN IN CAPTIVITY ARE WORLD'S TOUGHEST ACTORS

(Continued from page 21)

their trainer, who for fifteen years has made it his business to know animals, to differentiate between sweet and ornery characters, between honest and deceitful animals, Romeo and Toby are as different as are Smith and Jones to you.

Let's take Romeo as an example and follow his training for a moment. Six months before I saw Romeo for the first time, he had walked alone from his cage in the adjoining lion house, trotted nervously down the chute, and walked suspiciously through the gate into the arena. Foix followed.

IN A corner stood a pedestal, wooden platform thirty inches high. On it was a piece of meat. Motions of whip and stick drove Romeo closer and closer to the stand, the trainer finally blocking his progress immediately in front of the object. Urged by the snapping whip, the lion moved back until he saw the meat. He reared up, grasped it between his powerful paws, and made off to enjoy an unexpected meal.

After three days of this pleasing experience, Romeo saw two pedestals in the corner. To reach the meat, he was forced to leap onto the nearer platform. He grabbed the morsel, looked around at Foix, and suddenly discovered he was safe.

Each day the pedestals were moved farther from the corner toward the center of the arena. Then the smaller was removed. This forced the animal to leap unaided onto the taller stand for his reward. At last the meat was eliminated and the lion, which was deaf and had accomplished this maneuver solely through the aid of gestures and motions of the long whip and stick, found himself sitting on the small platform looking down for further instructions.

Foix noted that the lion showed unusual balance as he leaped onto the tiny platforms. He never faltered. The tryout indicated he might become proficient as a roller, or at walking a barrel or ball.

Eight days after his first leap for the meat, Romeo trotted into the arena to find the pedestal missing. In its place stood a large barrel-like roller, with two wooden wedges jammed against its curved surface to prevent movement. Again the trainer drove the lion into the corner and motioned him up. Growling defiance, the deaf actor slowly placed his fore paws on the roller and, after a long pause, leaped nimbly onto its side. Ten times during the three-hour practice session, Romeo jumped on the roller. Next morning, he went through the routine ten times more. The score of tries convinced him the odd-shaped contrivance would not move. Again, he was safe in the face of a strange situation.

The third morning the wedges were missing. In their place was a long handle affixed to pivots in the ends of the barrel. Foix stood at the end of the handle and again motioned the lion up. Romeo jumped, standing at ease. As soon as he had adjusted his muscles and relaxed, the roller began to move. Slowly, very slowly, it turned under his feet. As it rolled across the arena, the lion walked cautiously backward to keep his balance.

Within a few days the rising young star was centering himself naturally. Then came the supreme test. With the handle removed, the man stood only a pace distant from the lion's sober face and motioned forward with his whip. Romeo obeyed instantly. His ponderous paws shoved down on the forward side. He started walking backward, at the same time pushing forward, coordinating his muscles nicely as the device rolled across the open arena.

Having mastered a cylinder which would

move in only two directions, front and back, the lion was ready for its graduation to a large ball requiring perfect balance in all directions. Again the trainer protected him against mishap which might destroy in a few seconds the confidence he had worked many days to build up. The ball was placed in a trough, whose sloping edges prevented side rolling. Romeo walked the ball with the same assurance he had trod the roller. After three days of this routine the trough was removed, and, with only slight hesitation and a few near-falls, he rolled the large ball freely in whatever direction the trainer motioned.

Never during the arduous lessons did Foix touch the lion with the whip, for he has learned in perfecting a dozen lion and tiger acts that only a few lions or tigers will suffer the lash without retaliating. Most of them will turn on the trainer, and Romeo early showed his displeasure at being struck. Lions raised in captivity, he has found, harbor a greater silent fury than their wilderness-born brothers.

SIX four-year-olds tried out as leapers. For long hours they stood before the pedestals, which were separated by not more than four feet, apparently anchored to the ground. Only one did the trainer dare flick with the whip. To the others he talked, pleaded, cajoled, motioned. Of the four, Rassow alone took the jump with ease, extending himself more and more in the standing broad jump as the pedestals were moved apart.

Rassow, this lithe and relatively light but powerful specimen of lionhood, was next in training for a feat, tedious and difficult for the trainer to prepare—a fifteen-foot standing leap over the backs of seven lions. He did not make this long leap at the outset. At first he merely stretched from one stand to another, placed against the bars. Foix, "talking" him across the open space, was the sole impelling force which caused the lion to act.

Gradually the pedestals were moved apart and away from the bars. When he was able to leap ten feet, four of his mates—Toby, Pasha, Mars, and Ben Turpin—known by now as steady lions, were moved, one by one, onto tiny pedestals between the larger platforms. Previously every step, from the initial leap off the pedestals on which these four teammates sat to standing immobile on the low stands, had been rehearsed many times. When I viewed the painstaking practice, the quartet of "stand betweens" had become so accustomed to the performance they stood quietly, often with eyes closed, as Foix cracked the whip and urged Rassow over their backs.

FIRST from one side, then the other, Rassow walked sedately onto the near platform, hesitated, tensed his muscles. "Over the top, Rassow," shouted the trainer. "You can do this trick. I mean it. Up, up, over the top! Jump!" And Rassow jumped, as though he knew when Foix reached the limit of his patience. The quartet below remained motionless because in repeated rehearsals they had learned that no harm would befall them, while Rassow leaped from pedestal to pedestal secure in the knowledge the wooden structures would not give way under the impact of his paws.

Three times during their appearance in the arena all lions were on the floor moving from and to their seats, each taking part in some act. They usually sat like children in school, facing the teacher and awaiting a call to recite. Seldom did one move unless called. When some obstreperous beast descended to the floor, he was (Continued on page 123)

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HOME-GROWN LIONS ARE TOUGHEST ACTORS

(Continued from page 122)

met with a stern voice, sometimes the whip and, infrequently, should he refuse to give way before the trainer's advance, the long stick. No steel rods, prodded through the bars by helpers, drove them into submission and no collar and chain dragged them to their places. They responded solely to vocal commands, motions, and the physical urgings of one man.

Mars, bottle-fed like a baby, once lay in Gay's arms and held his own bottle while milk gurgled down his throat. His mother abandoned him and two brothers at birth. All three thrived on bottles for several months. One became irritable and high-strung, the second docile, and Mars developed a streak of meanness. Yet Mars displayed unusual intelligence, an ability to concentrate on new problems, and a powerful physique. So he got the call to appear for training despite his somewhat stubborn character.

NOT infrequently Mars lashes out with his long, sharp claws, yet the trainer dares not touch him even lightly with the whip. "If I overstep the line," he told me, "Mars will rebel. That means trouble, possibly serious trouble. And I don't want any difficulties with eighteen of these beasts in the cage."

Yet Foix works all of them together, even to standing head to tail in a pyramid, without which no lion act is complete. He treats them gently when they are working well but becomes hard as steel when some brute refuses to understand a command. On the second day of my visits, he brought them in from their cages, ordering them immediately to their seats. The lions trotted around the arena and several leaped onto their pedestals. Again several delayed, pacing back and forth nervously against the bars which denied them liberty.

Abdullah took a seat—the wrong one. Mars declined resolutely to leave the ground. Foix became insistent.

"On your own seat, Abdullah!" he shouted, advancing toward the row of lions with whip and stick ready for action. "On your own seat. I'm not fooling." Abdullah moved, turned to face front, and sat.

"All right, you fellows," he went on, facing the other restless animals. "Caesar, Mars, Apollo. Take your seats."

Caesar and Apollo jumped but Mars refused. The trainer shifted the whip to his left hand, reached into a pocket for his pistol, and waved it toward the lion. "I said seat." Mars glanced at the weapon and moved grudgingly to his place.

"Can't take these fellows by the scruff of the neck," Foix explained a moment later, "but they don't like to have the blank cartridges pop in their faces. These, by the way, are more effective than bullets. If I ever should pop a lead slug into one of these babies that would be the end—of the lion or me. A wounded lion gives no quarter, and I'd have to kill him or be killed."

PERFORMING lions seen in circuses usually are trained in threes and fours until the act is finally assembled. Each year replacements join the acts to take the places of those lost by accident or death. At the Gay Farm, the entire group started together and progressed in their training as one big growling family.

Foix told me he would not attempt to mold an act containing more than two or three really mean animals. One might turn on him at any time and with the trainer injured, the act is out of business until he recovers or some other expert accustoms the entire troupe to his methods.



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MODERN MAGIC OF THE MOVIES

(Continued from page 32)

the sound recording an earlier scene.

Whereas many sounds may be recorded after the picture is made, big musicals usually are pre-recorded. Action is fitted to sound instead of sound being fitted to action. That is, each number is written and "scored," perhaps by a large orchestra and vocalists, before the microphone, but without the camera. Thereafter, the cameras turn as though producing a silent picture, while the artists and musicians sing and play to the accompaniment of their earlier recording. Since the sound play-back mechanism and the silent camera are interlocked, sound and picture match perfectly, frame by frame.

"THIS is a usual procedure," Heman explained, "because the microphone must remain in the same place to obtain a proper original recording. Otherwise, when close-ups and long shots were combined, the mike would show in some scenes. Here, too, we can move the camera anywhere, yet have the same quality and volume of sound in all scenes."

Occasionally the picture is made first, the music recorded later. Recently, sitting in a monitor room looking down through triple soundproof windows on a large scoring stage, I saw how this is accomplished.

On the screen, an actor was shown playing a mouth organ, while Shirley Temple laughed, waves lapped at the sandy shore near-by, and a large crane flapped its wings rhythmically. Near a microphone, the musical director led a musician through four bars of music. After three rehearsals, the director ordered a "take."

In the dim light below, I could see the musician going through the routine of following the moving wings with music. As the picture ended, the director spoke into the microphone: "A 15, reel 2 A, take 4, cut."

"That fellow grunts when he plays," commented the sound recorder.

"It's O. K.," said the director of re-recording. "Shirley's laughing, and there's some wave noise to drown the grunts."

But the flapping wings. Who put rhythm into the old bird?

"His owner threw nuts at him," Heman told me. "Each nut produced one flap. So that was easily timed."

No sound effects heard with a picture are "original." All are re-recorded once, and sometimes twice. This includes the human voice on occasion. When you hear a telephone conversation on the screen, for instance, you may be sure tricks have been played with every word uttered. Through electrical filters and boosters, the experts have changed the quality of the voice to make it sound as though coming from a telephone.

No matter how perfectly technicians and actors have done their work, however, there yet remains the important job of turning the sight and sound into flawless pictures on film for the projection machine.

EVERY night, between sunset and dawn, the 2,000,000 or more feet of film which have rolled through 500 cameras in sixty Hollywood studios are developed in laboratories.

In the film laboratories, experts of long experience work with scientific precision and on split-second schedules, for a single crew may be called upon to develop as much as 86,000 feet of negative in a six-hour run. Suppose we look in on a developing laboratory. The time is ten o'clock at night. We're looking at a long tank chopped into sections; four contain developing chemicals, one in the middle is filled with water to rinse off the developer, the next three contain chemicals which harden the coating on the developed film, while the re-

maining four contain water which washes off the fixing solution.

Over the spools of the metal framework now suspended above the tanks, and through the glass-encased drying cage beyond, is threaded a mile-long leader—blank film used to pull the negative about to be developed through the various baths. At the near end, Mike Leshing, veteran laboratory director, splices the leader to the undeveloped film, contained in a lightproof magazine.

WHEN the film is ready, he opens a switch, plunging the room into darkness. Unable to see, I asked what was going on.

"We've got 5,000 feet of film here," Leshing explained. "It's running through the tanks at a speed of ninety feet a minute, the same rate at which it travels through the cameras. The developing fluid is circulated constantly at a temperature of sixty-five degrees."

"How do you know whether the developer maintains proper strength?"

"Every thirty minutes," he continued, "we develop, along with the picture, a strip of film which has been exposed to a series of light values. Each is known, and by testing the strip we know whether the developer is working with the proper strength and speed."

After what seemed in the darkness an interminable silence, Leshing again turned the switch and lights flooded the room. We walked to the end of the glass cabinet. There I saw on a large reel the mile-long series of scenes, developed, fixed, and dried. Each foot of that long strip had been immersed in the various tanks and speeding through the drier for exactly one hour and one minute.

But this does not end the laboratory's job. A short strip from each "take" is tested on a novel machine which reveals the exact density and shows which of eleven intensities of light will be required to print a perfect positive. Instead of varying exposure time in accordance with film density, as in printing still pictures, the movie printer varies the light intensity. Where the density of the negative strip changes, the experts punch small indentations in the side of the negative film. A tiny roller runs down the edge of the film in the printer; when it comes to one of these indentations, it drops into it, makes an electrical contact, and automatically changes the light to the correct intensity. Thus, the final strip which goes through the theater projector is uniform throughout.

From each negative, the laboratory experts make two black-and-white prints, one for cutting, the second for stand-by. They also produce a lavender print. This serves as insurance in case anything happens to the master negative, for from it a duplicate negative can be copied. The purple-tinted film is used because it gives a more sharply defined image than black-and-white stock.

AFTER the final cut is O. K'd, the print is returned to the laboratory. Then the original picture negative and the sound negative are cut to match the cutting-room print, and from the two a single, composite print is made. For the first time the narrow sound track, which runs like a zigzag line down one edge, and the picture have come together on a single strip of film.

We near the end of our story. By express, the negative is shipped to New York, where 350 prints are made and released to the nation's theaters. What happens from this point on is not a matter of science, but of skillful promotion. The wizards of Hollywood have wrapped into a mile and a half of film all their technical skill. Whether it becomes a financial success depends upon the uncharted whims of the public.

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EXPERIMENTS EXPLAIN MYSTERY OF ADSORPTION

(Continued from page 51)

the experiment with sulphur, using water as the indicating liquid. This device employs a pair of glass cylinders, which may be fashioned from broken test tubes, and are arranged with connections of tubing as shown in the accompanying diagram. One of the cylinders serves as an expansion chamber for the gases in the tube, and the other as a reservoir for the water they displace. The manometer is filled with water and the level noted. When the sulphur burns, water is displaced from one of the cylinders into the other, or perhaps rises a little above the top of the second. Eventually, however, it should return to its original level. Of course a water "manometer" of this type does not indicate a wide range of pressures quantitatively, since its bore is not uniform. However, it is useful in this experiment because it does enable us to see whether the pressure is the same at the beginning and end of the test, and this is all that is required.

BEFORE you put away the supply of sulphur that you drew upon for the preceding experiment, you should take advantage of the opportunity to observe the crystals that this element produces. Heat a little sulphur in a test tube, crucible, or evaporating dish, until a pale yellow liquid forms; avoid overheating. Pour the molten sulphur into a paper cone, which you can make by cutting off the corner of an envelope. If a projecting tab is left in the cut-out paper, it will serve as a handle and protect your fingers from the heat of the sulphur.

As it cools, the material will form a crust over its top. A few seconds after this happens, break the crust, and tear the paper and the adhering sulphur apart. You will expose an interior mass of fine, needle-shaped crystals.

Preserve these crystals for several days, and you will see them undergo a marked change. When first formed they consist of what is known as beta sulphur. This spontaneously changes into alpha sulphur, which is much lighter in color. The ability of sulphur to exist in two entirely distinct solid forms is considered to be one of its most remarkable properties.

ARTIFICIAL WOOD AIDS IN HOME DECORATION

(Continued from page 37)

made to match and harmonize with the wall treatment, or individual pieces could be treated to make them resemble furniture made from rare and costly woods.

Stone surfaces of various kinds are simulated by another similar plastic material which is supplied in the form of a thick paste, and in a wide choice of colors. This is brushed over tile, plaster, glass, metal, canvas, wall board, or practically any other inside wall material. The puttylike mass is then troweled down smooth to resemble a polished stone surface, or roughed up with an ordinary paint brush into a coarse, uneven finish, as desired. The paste dries in a day, the makers claim, and within forty-eight hours after the application it hardens to the consistency of concrete. The finished surface is washable as well as durable; and like the artificial wood paneling, it is said to be unaffected by heat, cold, or moisture.

Here, again, the laboratory supplements nature by creating inexpensive but faithful imitations of rare natural products, valued for their beauty and for the associations they have acquired through centuries of use in the habitations of man.

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GUS TELLS HOW TO HUNT SQUEAKS AND RATTLES

(Continued from page 56)

right up the screw-driver blade, and you'll hear them loudest if the handle end is pressed as close to your eardrum as possible. If the noises you hear sound like bedlam let loose, naturally you won't be able to pick out any one sound, so the answer is to slide the screw-driver handle down in your clenched fist like this," Gus demonstrated, "squeezing tighter to close the air passage from the end of the screw-driver handle to your ear till the sound is just strong enough."

"Sort of a one-fist volume control, eh? I should have thought of that," Sisson commented, as he tried the stunt with the screw driver in his own hand.

"THAT'S the idea," said Gus. "But knowing how to use the screw driver is only a part of the job. The rest is where the patience comes in. The whole trouble with finding these darned noises is that most of the time they don't sound like what they are, and they always seem to come from where they aren't. That's because any noise is the result of a vibration and you can't hear it till the vibration has been put on the air so it can get to your ears. Now, the actual vibration nearly always starts inside somewhere, and the direction it takes in coming out through the metal parts depends on how easily they vibrate. That's where the screw driver helps, because it picks the vibration right out of the metal and carries it directly to your ear."

"Sounds all right, but how does it work out?" Sisson asked.

"I'll show you," said Gus, reaching for the screw driver. "Did you notice that funny little bumping noise that seemed to come from the door latch?"

"Notice it!" exclaimed Sisson. "I've spent hours trying to get that latch to stop thumping like that. I've got it so tight now you can hardly get the door open."

The bumping that Gus had noticed occurred irregularly when the car was in motion, and also while it was standing still at certain motor speeds. Sisson worked the throttle up and down while Gus listened with the screw driver, first all around the latch, then at different points on the door, and finally at a number of points near its upper edge above the hinge.

"Must be right in here," Gus muttered, swinging the door open. "Yes, here it is. See that shiny spot on the door frame, and this bright spot on the door right where it closes on it? The latch buffers were set a little too tight in the first place, so the door was sprung over just enough to cause a metal-to-metal bumping right there. Tightening the latch buffers just made things worse."

"Well, it's a relief to find it at last, even if you do prove I'm dumb," grinned Sisson. "Now let me listen to see if I've got the hang of it."

"GO TO it," Gus suggested, handing over the screw driver again. "You'll hear the thump at any point on the door, of course, and quite loud too, but it'll be plenty louder right near where it's bumping."

"It certainly is," agreed Sisson, as he reached that spot with the end of the screw driver.

"If that had been a loose body bolt or a bad rubber mounting," Gus explained, "it might have seemed to be coming from the door, or even the roof of the car, or any other place at any distance from the actual source of the noise; but when you get the screw driver on the job, you can soon get the trouble pretty well localized, and then it's just a matter of investigating everything in that area to find out what is wrong. After all, finding exactly (Continued on page 127)

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GUS TELLS HOW TO HUNT SQUEAKS AND RATTLES

(Continued from page 126)

where the noise starts is the hardest part of the job. Fixing it is the easy part.

"Of course," Gus went on, as he worked on the door, "there's lots of queer noises you may get in a car that a screw driver won't help you locate except to tell you where they aren't. Take a loose manifold bolt that lets gas escape in a sort of grunting squeak—it sometimes sounds mighty like what you'd hear if a piston ring was broken and jamming a little. Touching the cylinder wall just below the edge of the water-jacketed part with the end of the screw driver would bring such a piston-ring noise to your ear good and loud. If you didn't hear it on any cylinder, that would be finding where it wasn't. Then it would be a case of spotting the leaky gasket by sight, or actually feeling the blast of gas as it escaped from the manifold.

"SOMETIMES, a spark plug cracks or develops a gas leak in such a way that it makes a hissing noise like the hiss you get when you idle the motor slowly and the rings on one piston are broken. That's another case where the screw driver would tell you it couldn't be broken rings."

"In other words, the screw driver is no divining rod," laughed Sisson. "It's just a sort of extension ear."

"That's it, exactly," Gus went on. "You've got to use your eyes, and plenty of common sense, as well as your ears and patience in finding car noises. And some aren't worth fixing when you do find 'em. Fellows come in here yelling that there's a squeak in the generator bearings. They don't know that a generator commutator and brushes can cause an unholy squeak that sounds just like a dry bearing. The best thing to do about a commutator squeak is to forget it; it's most likely to go away in a little while, anyhow."

"Another fellow came barging in here the other day and wanted to buy enough rubber hose to renew the windshield-wiper line because he said the wiper wouldn't work and he could hear the hiss of a leak in the pipe. It hissed all right, but when I pulled off the hose at the windshield wiper and held my thumb on the end of it, the hissing stopped, proving that it couldn't be the hose. The real trouble was in the wiper itself."

"That might have fooled me too," Sisson admitted. "Well, some day I suppose they'll get around to the point where they can make really silent cars."

"HUMPH!" snorted Gus, disgustedly. "You want a silent car, eh? By golly, there's no satisfying you youngsters! If the modern car wasn't so darn near completely quiet you'd never even hear any of the little mouse squeaks and trifling rattles that get your goat now. You'd appreciate how quiet the modern car really is if you had driven one of the threshing machines they sold for cars in the old days. Believe me, it had to be a man-size rattle or squeak to be heard above the general rumble and roar of those old-timers. But, even in those days, noises didn't always mean what they sounded like."

"I remember taking a ride one night with a fellow who'd had some trouble with the front-wheel bearings going dry and squeaking—they were plain buggy-wheel bearings, not ball bearings—and as we rounded a bend in the road his ears caught the shrill squeal that meant a dry front-wheel bearing to him. He slammed on the brakes and we came to a stop, but the squeal went right on. It was a combined concert from the crickets, katydids, and frogs in the batch of woods that bordered the road, and if there's anything that sounds more like a squeaking bearing, I don't know what it is!"

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Plant Breeding Produces Better Vegetables

(Continued from page 35)

year, these little-noticed improvements creep into vegetables. All result from long experimentation and selection. Here are two outstanding changes:

Eighteen years ago, "Kentucky wonder" beans were mixed with tough and flat-podded beans, and were generally unsatisfactory. At the close of the World War, a seedsman went into a field near Redwood City, Calif., and picked out 100 vines. When the pods reached the eating stage, he marked each plant, giving it an individual number. Two months later the plants were harvested, the seed from each being saved in separate paper sacks.

Next year, the seed were planted in a small plot, each properly identified. Again, seed from the plants of this generation which proved satisfactory were saved. Two years after the first planting, more than nine tenths of the offspring from the original plants had been discarded. Nine years after the first planting, there were 1,000 acres of Kentucky wonders in production for seed—and all could be traced through various lines to a single mother plant.

THESE wizards of the trial grounds perform other feats of magic. Take white cauliflower, for instance. Seeds from which American crops were produced once came from Italy. Farmers found their crops maturing at all dates. Seed experts took the situation in hand and, by selecting plants which ripened at given dates and producing others from those so selected, finally created a series of strains which mature with the regularity of clockwork. Now, seed sown in late spring produce large white heads ready for the kitchen in November, December, January, February, March, and April, depending upon the strain planted.

Once the strain is "fixed," or promises to reproduce year after year the same quality vegetables, the growers swing into big-scale production of seed. Though this is considered purely a manufacturing process, here again every effort is made to keep the seed clean and send to the market gardeners—and amateurs, too—only the best quality of seed.

At Salinas I was privileged to witness the almost microscopically clean methods employed in producing stock seed. They are the seed which next season will be planted on the seed-producing grounds, which in turn will furnish the seed for gardeners everywhere.

NOT all seeds are harvested alike. Many are pressed out by large horse-drawn rollers. Others, such as onions, are spread on squares of canvas and the seed threshed by hand. But that's only half the job. Since the light bases of tiny white buds appear among the black seed, buds so light they cannot be separated by hand, the seed next are poured into long troughs filled with water. They sink to the bottom and the buds are skimmed off. Finally, the seed are sieved and dried a second time.

Take tomatoes. The fruit is picked dead ripe and sent through a thrasher immediately. Heavy pulp and skin pour out one end of the machine, seed and juice flow down flumes into barrels, where they are fermented for seven days. At that time the seed and juice are washed with water as they flow down wooden flumes. This process removes the jelly surrounding each seed, yet preserves the fragile whiskers attached to each. In a sim-

ilar way asparagus seed, which grow in a berry, are fermented and washed.

After each crop is thrashed, no matter if the next batch comes from the same seed grown in an adjacent field, the thrashers are cleaned to avoid any possible mixing. Thus are strains kept pure during the making of seed.

By these and similar methods 7,000,000 pounds of small seeds—not to mention huge quantities of peas, beans, and corn—flow from the seed farms to the nation's growers each year. These represent thousands of varieties. Lettuce alone reaches the country's dinner table in 200 different forms, from crisp-leaved solid heads to soft-textured heads.

WHILE improving the many varieties, seed producers are also constantly truing the stock of seed produced on the trial grounds, most of which are located in Michigan, Idaho, Washington, and California.

The vegetables on your plate tonight may be close relatives of the world's champions of next year. Each season, seed growers submit their finest new strains to a committee of twelve judges, who plant and grow the seed without knowing which is which. Those receiving enough votes are crowned winners in the All-America Selections.

Here, for instance, are the "new" vegetables for 1936, strains which have shown enough improvement under scientific care and culture to receive awards of merit from the All-America Council. Three come from Holland.

A new carrot, which varies in shape from globe to olive, is long-standing, is bright scarlet, and remains in eating condition longer than older varieties. It has uniform roots and a bright color, is crisp and solid, and ties into a neat bunch.

The new kohlrabi has a shorter top and

shows more of the streamline effect than heretofore, while a new pea combines the best features of three former peas. Through the skill of the seedsman's crossbreeding, it has "little marvel" pods, grows on the "perfection" vine and attains "Thomas Laxton" maturity.

This year witnesses commercial production of an exceptional new parsley, which attains a deep green color and has uniform leaves. This is one of the eye-appeal items you'll find at the market.

Too, growers have given the nation a new type of corn with zigzag kernels. Ears are large, kernels deep, and taste is sweet. Selection of plants whose performance proved their quality and strength also has produced a new beet, of deep red color and vigorous growth. And a new tomato, which often will yield seven pinkish-skinned fruit in a single cluster. Better and larger yields are promised for this new product.

THESE are not really new plants, but represent gradual changes in old families. Their existence began in the flower on the mother plant. Meantime, each plant has lain dormant—a miniature, if you please—in the seed.

Dr. J. T. Buchholz, professor of botany at the University of Illinois, has examined many thousands of common garden seeds in an effort to learn more of the mysteries of reproduction. What does he see underneath the opened coat of, say, the seed of a squash or radish?

An embryo plant with two seed leaves opposite each other, and between them a small bud, with the almost invisible beginnings of a root below. When germinating in the earth, the leaves unfold at the end of a root. Oddly, they always unfold within the soil.

Some seeds, in addition to the embryo and seed coat, contain a nutritional substance known as endosperm, from which we get most of the starch in wheat, corn, and other cereals. In its early stages, the endosperm supplies food to the tiny plant until it breaks through the coat, which meanwhile protects the embryo against injury and admits air and water during the germination period.

Seed growers know exactly what their seeds will yield under given conditions, yet no matter how carefully they endeavor to supply the nation with seed which will produce sturdy plants having both food value and beauty, they cannot guarantee your plot will be free from all other plants.

THERE'S a reason; several reasons, in fact. For, in addition to the natural growth of weeds already present in the soil, the oceans bring to our shores seeds whose skins are impervious to salt water, and which later are carried long distances by the winds. Some seeds carry their own parachutes in the form of tufts of hair, which enable them to soar with the breezes. The family dog or cat may drop foreign seeds from his coat into the garden. Some grass seeds count several millions to the pound, and adhere to birds' feet, to be dropped during flight. Other seeds actually possess air chambers and float for weeks or months on rivers and lakes, eventually to be carried aloft by air currents and find a resting place—in your garden.

However, the skill and patience of the seedsman have done their part to give you better vegetables.



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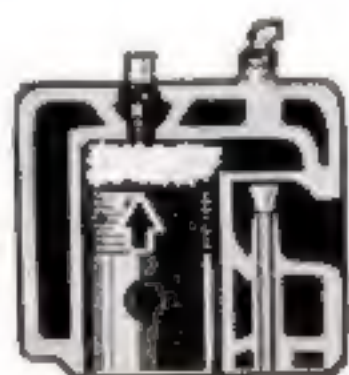
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